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Index to Advertisers and Classified Index Following Reading Matter.

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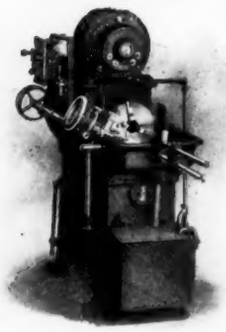

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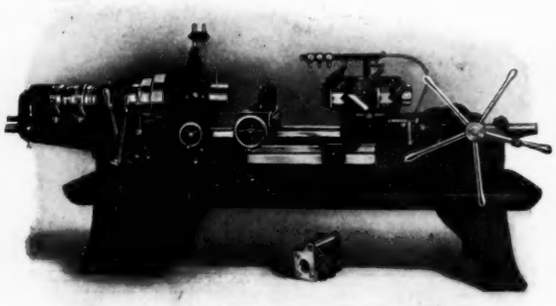

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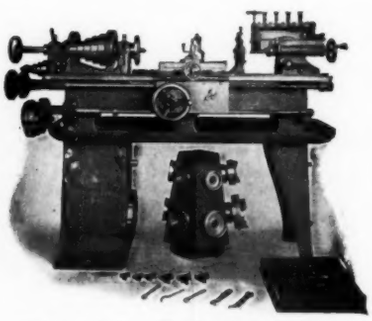
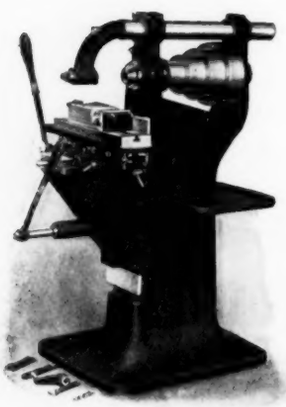


10 in. x 5 ft. Toolmaker's Lathe.



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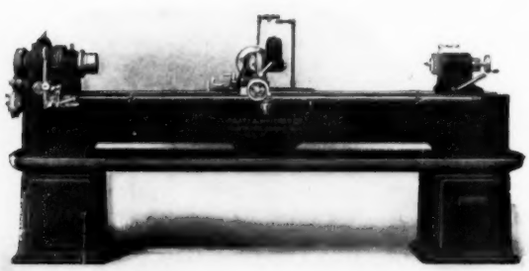

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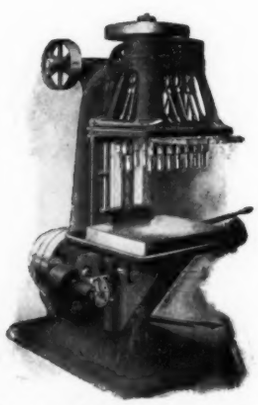

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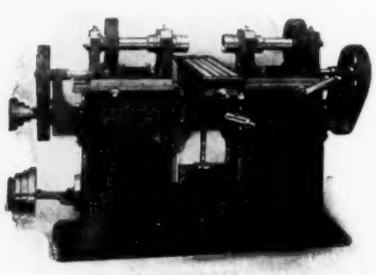
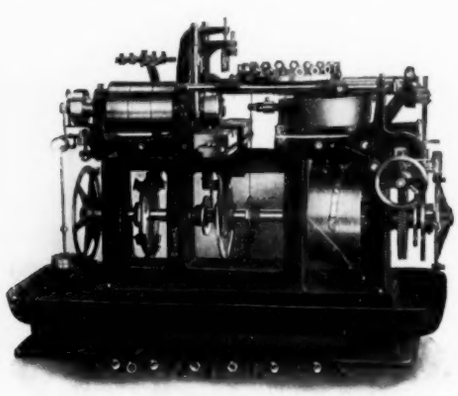


Double Column Milling Machine.



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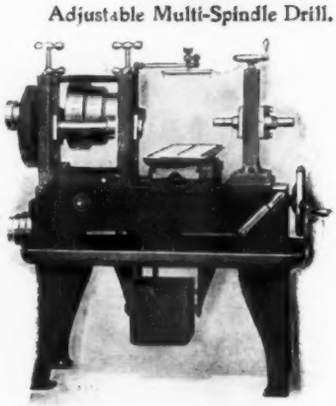
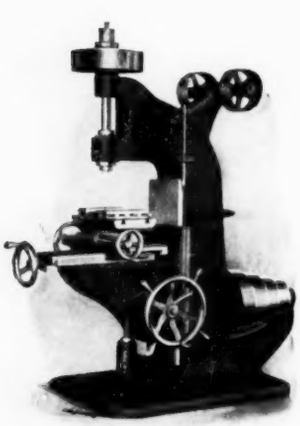


Lincoln Milling Machine.



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The Siemens-Schückert Works in Germany—Nuremberg.

BY EMILE GUARINI.

As a step in the direction of the electricity trust, which is very generally contemplated, four of the greatest electric companies of Germany have already formed into two groups, one of these named "Siemens-Schückert," constituted by the amalgamation of the ancient firms Siemens & Halske, of Berlin, and Schückert, of Nuremberg, the other formed by the union of the "Union Elektricitäts-gesellschaft" and the "Allgemeine Elektricitätsgesellschaft." These agreements, which in a short time will undoubtedly be followed by several others, are considered as a necessity in Germany, on account of the severe strain the electric industry is undergoing in the empire. These consolidations, it is hoped, will not only decrease the general expenses, but also produce a greater unity of types and to a certain extent restrain competition, or at least limit the latter with regard to the four companies mentioned, between the two groups which have been formed. As far as the group Siemens-Shückert is concerned, the amalgamation is hitherto neither absolute nor complete. Siemens & Halske exist still and remain independent for certain branches, such as telegraphy and telephony, in which this firm has created for itself a remarkable speciality. The two firms of the group Siemens-Schückert are numbered among the largest, not only of Germany, but of Europe and the whole world. They have carried out electro-mechanical and electrical undertakings of the most imposing description. We mention only the central stations of Bangkok, Pekin, Tokio, Batavia, of the Cape, of Johannesburg, of Para, Valparaiso, Mexico, San Salvador, etc. The cables of the 5,000 horse-power central station of Johannesburg measure 300 kilometers, those of the 1,100 horse-power central station of the Cape 310 kilometers.

A brief description of the works belonging to the group will allow us to get some conception of these imposing establishments seated at Nuremberg (formerly the Schückert works), at Berlin and finally at Charlottenburg and Nonnendam.

The concern, which was originated in 1847 by Lieutenant Werner Siemens (artillery) with the assistance of the engineer Halske, commenced with what is called nowadays the business of weak current apparatus, viz., telegraphy, railway bells, gutta-percha wires, etc. This was all that could be done in those days, but in 1866 Werner Siemens constructed a dynamo and laid the foundation of the use of high-tension currents. The fields of lighting and of motive power opened themselves before him and he entered them boldly. Later on, the electric working of tramways and suburban railways was added. The firm became then the most powerful of Germany.

The beginnings of the Schückert company were humbler still. In 1873 Johann Siegmund Schückert hired in a Nuremberg establishment called "Schwabenmuehle," a modest workshop, where he was for months busy repairing sewing machines and manufacturing surveyors' instruments and telemeters. Devoting his leisure hours to the study of electricity, he was induced to construct in 1874 the first trial dynamo machine worked by hand. The following year he supplied the first dynamo to the galvanoplastic works of Wellhoefer at Nuremberg. Later on, he substituted the flat ring for the Gramm ring. Afterward the firm undertook in succession the construction of arc lamps and projectors, then came the establishment of central stations and electric railways.

For a long time the firms competed on the world's markets, but with the new century this rivalry came to an end, and now they constitute a united group with a capital of 90,000,000 marks ($22,000,000), the greatest ever established in the German Empire. The operations of this giant organism are subdivided as follows:

FIG. 1. NUREMBERG PLANT OF THE SIEMENS-SCHUCKERT WORKS.

The works at Charlottenberg and Nuremberg are the most important, as much for their extent as for the variety of their products; they build all kinds of apparatus for lighting, power transmission and traction. They manufacture dynamos, motors, transformers and complete installations for ship service, for electric automobiles, mining and other locomotives, etc. At the Nonnendam works the specialty is the manufacture of cables and conductors of all kinds. These are the centers of production, Berlin being the chief commercial and distributing center, Nuremberg serving Wurtemberg and Bavaria. The firm with its numerous branches employs a complete staff of scientists, physicists and engineers among whom are found first-class men whose experience, inventive ability and constructive talent are constantly exercised.

The Nuremberg works, shown in general view in Fig. 1, include at present the "old works" of the Schlossäckerstrasse and the three "new shops" of the Landgrabenstrasse and of the Humboldtstrasse. The old works no longer contain any workshops, properly so-called. They shelter only provident institutions for working people. They include a stewardship exclusively intended for the employees and laborers of the Schückert establishments, a supplementary practical school for the apprentices in precision mechanics and mechanical construction, a refuge for male children subject to compulsory education, a cooking and domestic training school for full grown girls, a bathing establishment for laborers, employees, etc.

The works No. 1 include the three administration buildings, the electric laboratory, the shops for the manufacture of continuous-current machines, arc lamps and measuring apparatus, etc., and also the packing rooms. The great yard extending at the back of the administrative buildings is used as a depository for the dynamo frames and other massive castings and is supplied along its whole length with a traveling crane of 10,000 kilograms (10 tons).

The shops where the great continuous-current machines are constructed possess two bays, 100 meters (328 feet) long. On one side is the machine shop, containing especially strong machine tools and a gallery for lighter machines; on the other side is the fitters' shop and the laboratory for testing the continuous-current machines. The machines of small and medium size are worked by electric motors, while steam engines are used for the larger machines. Next to the great hall is a group of bays forming sheds, where continuous-current machines up to 50 horse-power are constructed. On one side of the sheds is the shop where the armatures of the great machines are coiled, and on the other side the shop where the reels of electros are coiled.

The works No. 2 include two buildings, one for the administration, the other

for the chemical laboratory, with shops for alternating-current machines and transformers, for tramway motors, motor carriage trucks, locomotives and various other sections, such as foundry and forge, testing room for alternating-current machines, central station, carpenters' shop, modeling shop and pattern store, shop for polishing mirrors and constructing projectors, and also various sheds.

The largest shop is the alternating-current machine shop. Its facade measures 175 meters (574 feet). It has a two-storied gallery running all along and contains in a built-over area of 5,600 square meters, an available space of 10,000 square meters (107,640 square feet). Alongside the walls are the great machine tools, especially three horizontal lathes capable of working pieces of 7.70 meters diameter.

In the middle of the shop, Fig. 2, are mounted the alternate-current machines of all sizes. A set of portable machine tools, worked by electricity, facilitate the working of the heavy iron castings. The offices of the factory are on the first gallery. There also are manufactured the small motors and transformers, there are coiled the electric reels and those of the transformers, and a lot of lathes also are

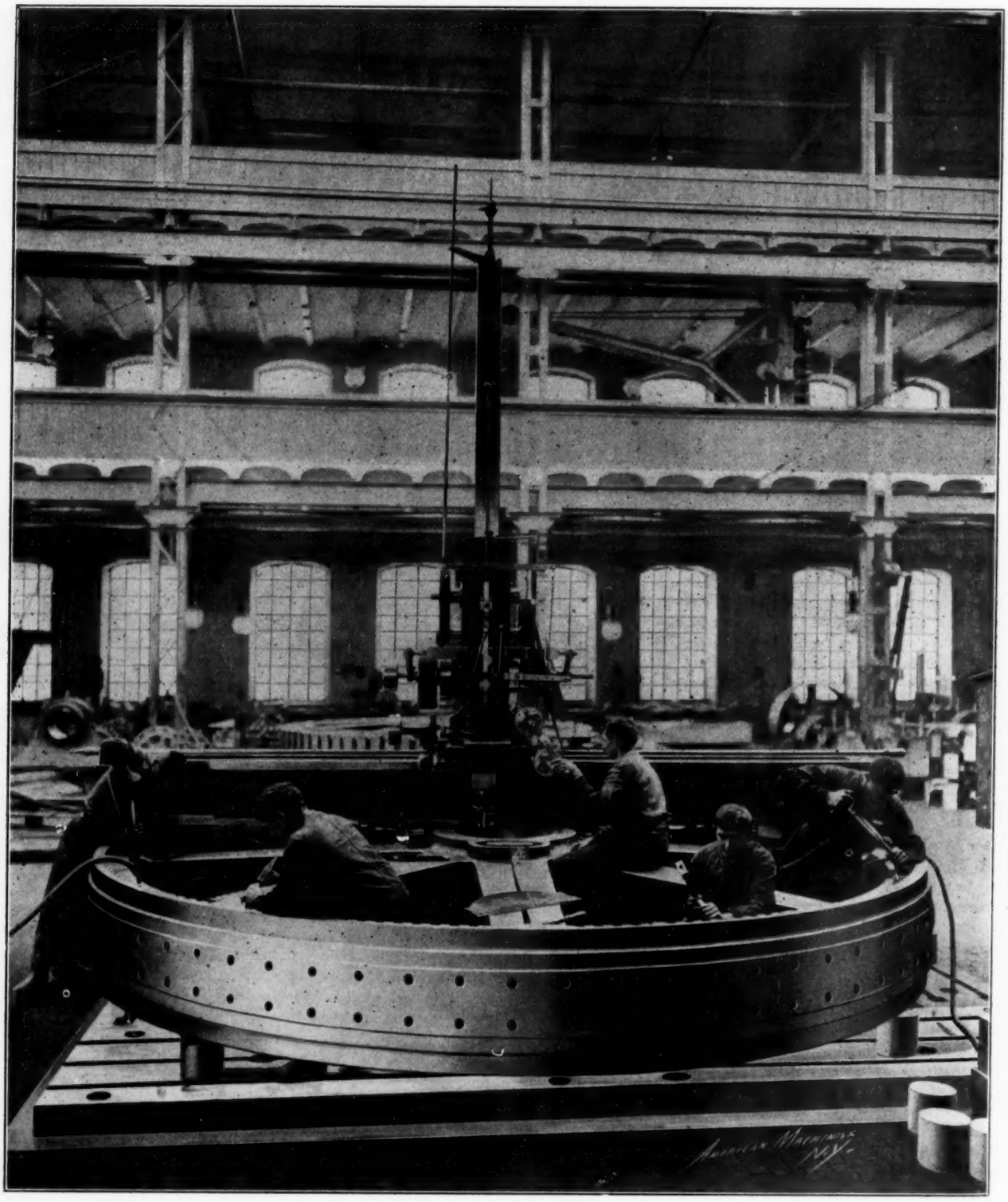


FIG. 2. INTERIOR OF LARGEST NUREMBERG SHOP, SHOWING THE TWO GALLERIES.

in operation. On the second floor gallery are coiled the three-phase current motors and the iron sheets for armatures are cut out. The entire shop is provided for its service with three powerful traveling cranes of from 20 to 30 tons. There are, besides, small cranes, electric lifts, etc. Works No. 3 contain, besides a dwelling for the employees, the packing shed, the store office, a bathroom, stables and a storage for bicycles. The current for driving the works is generated by three central stations. Taken together, these central stations, of a total power of more than 3,500 horse, are equal in importance to the electric works of towns of 100,000 to 150,000 inhabitants.

To many one of the most interesting views in the Nuremberg shops is that given in Fig. 5. This is a shop devoted exclusively to the instruction of apprentices in practical work. It is in charge of a competent man, and the boys do no repetitive work, but are given a variety which will most rapidly develop skill and judgment. Nearly every boy, as will be seen, is doing a different thing, those in the foreground evidently working on calipers and squares, while the other work in sight is of the repair or jobbing order.

The Electric Controller & Supply Company, of Cleveland, Ohio, recently made use of a novel method of selecting a representative to take charge of their exhibit at St. Louis. All their draftsmen were invited to write a description of the exhibit. To the clearest description of the functions and operation of the various parts 40 points, to the best statement of the advantages of the apparatus from the user's standpoint 30 points, and to the best composition from a grammatical and rhetorical standpoint 30 points were awarded. The winner of the contest was Mr. Geo. W. Megalhaes.

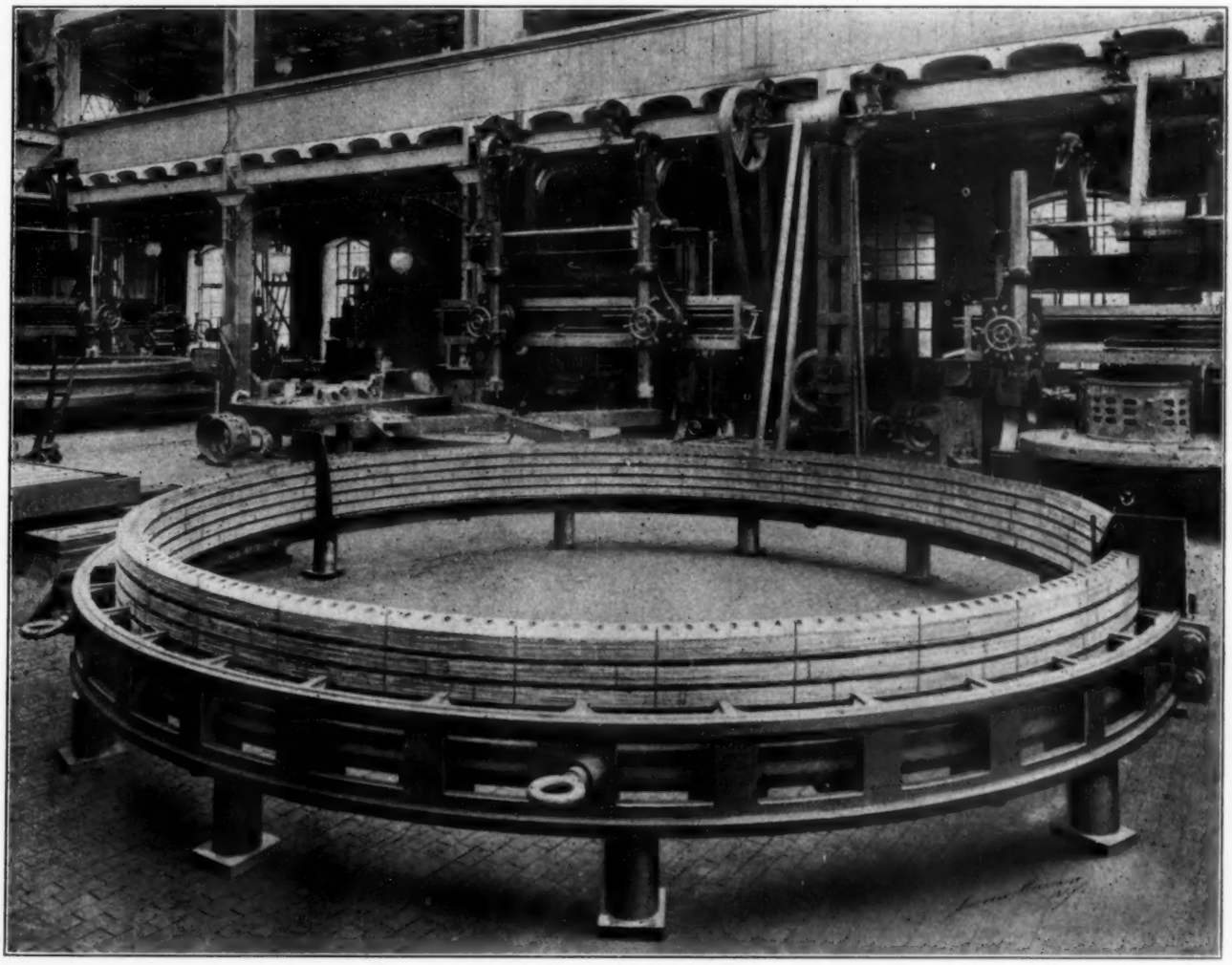


FIG. 3. ANOTHER PORTION OF THE LARGEST SHOP, NUREMBERG.

One of the most remarkable features is the shop, Fig. 4, for mounting the large dynamos, provided with several traveling cranes, one of 10 tons, another of 30 tons. Among the most remarkable machine tools of the works, we may mention a universal machine capable of working the largest armature rings, an enormous lathe for the armature spindles, a double drilling machine, allowing two workmen to work simultaneously and independently two different plates.

The Inventions of a Single Lifetime.*

BY JOHN E. SWEET.

According to the rules of our club, it devolves upon the retiring president to deliver an address, and I have selected for the subject of my remarks some of the things that have been invented and developed during my lifetime. I say "some," because I am not going to compile the Patent Office reports but comment on the growth of important inventions, many of which have been so long common that most of you may hardly realize that they ever were invented.

We need only go back a century or so to find that lights were kept burning in the churches, so that if one lost his fire, he could go to the church and recover it: or the flint, steel and a piece of punkwood enabled people to get a fire, but the practise when I was born was to bury a burning brand in ashes at the back of the fireplace, with a fair chance of having enough of a spark in the morning to start a blaze. A year or so before my time the friction match was invented, which was a thin strip of wood 3/8 inch wide and 2 or 3

*Presidential address to the Technology Club Syracuse, N. Y.

inches long, coated with some sulfur or phosphorous preparation which, when drawn between the folds of a piece of sandpaper, would start a blaze. Then came the lucifer match, very like our present match, except that it was made in this way: Blocks of straight-grained pine were cut about 2 inches long, one end being coated with glue and allowed to dry. These blocks were checked first in one direction and then crossways, so as to form splints about ⅛ inch square, the glue at one end and the splits at the other, curving the block so that it formed the section of a sphere. The ends of these splints were dipped in the sulfur or phosphorous fulminate, which would form a little lump on the ends of the sticks, and when pulled off one at a time, as they could be by breaking the glue, we had a match very like what we have to-day. Later they were made round, twice the length, held in clamps, both ends dipped and, when dry, cut in two and put in paper boxes, 100 in a box. Later still, the Swedish matches, made of wood that would not break when scratched, came in with the square match, and then the Diamond Match Company followed suit in shape but never in quality.

The match seems but a small thing to be called one of the important inventions, but when one realizes the magnitude of the industry and the bother that would result if we had to do without it, it will be seen that the match is a thing of no small importance.

In the days of my youth most of the houses were heated by and the cooking was done in fireplaces or grates, as is still done in England, except that here the fuel was wood and there soft coal. About that time, or perhaps earlier, they had learned to burn hard coal. Box stoves for heating by wood were brought into use and cook stoves were finding their way among the families that could afford to buy them. Square stoves were used for heating rooms. A few years later the Littlefield magazine or base-burner was invented, better cook stoves were made, and since then all of the numerous improvements in furnaces, steam heating and ventilating apparatus have appeared. What these things with innumerable other improvements have added to the comfort of living is entirely beyond the comprehension of the young people of to-day. Burning on one side and freezing on the other was a common expression, and pretty nearly a common fact. A heated sleeping room was an unknown thing.

The sewing machine, laundry machinery, hundreds of household conveniences, balanced sash and builders' hardware have revolutionized old conditions. Iron plows were in use, but their form has been improved and their cost quartered. Steam plows, wheel plows, harrows, cultivators, road rollers, horse rakes and tedders, the mowing machine and reaper, self rakers and self binders, horse-power unloaders and stackers, combined reapers, binders and threshers, the roller mill and its marvelous accessories have in the meantime been invented. The cotton gin has been improved, the linter and delinter invented, the compress metal cotton tie and round bale introduced and machines for hulling rice and coffee perfected. Roads have been improved, the stone crusher invented, asphalt streets introduced. Foods have changed from pork and potatoes to those innumerable in variety and better in quality, and now the laboring man lives as well as the wealthy did three-quarters of a century ago..

Just which has been the most valuable of all these inventions it would be hard to say. Stoves have no doubt added most

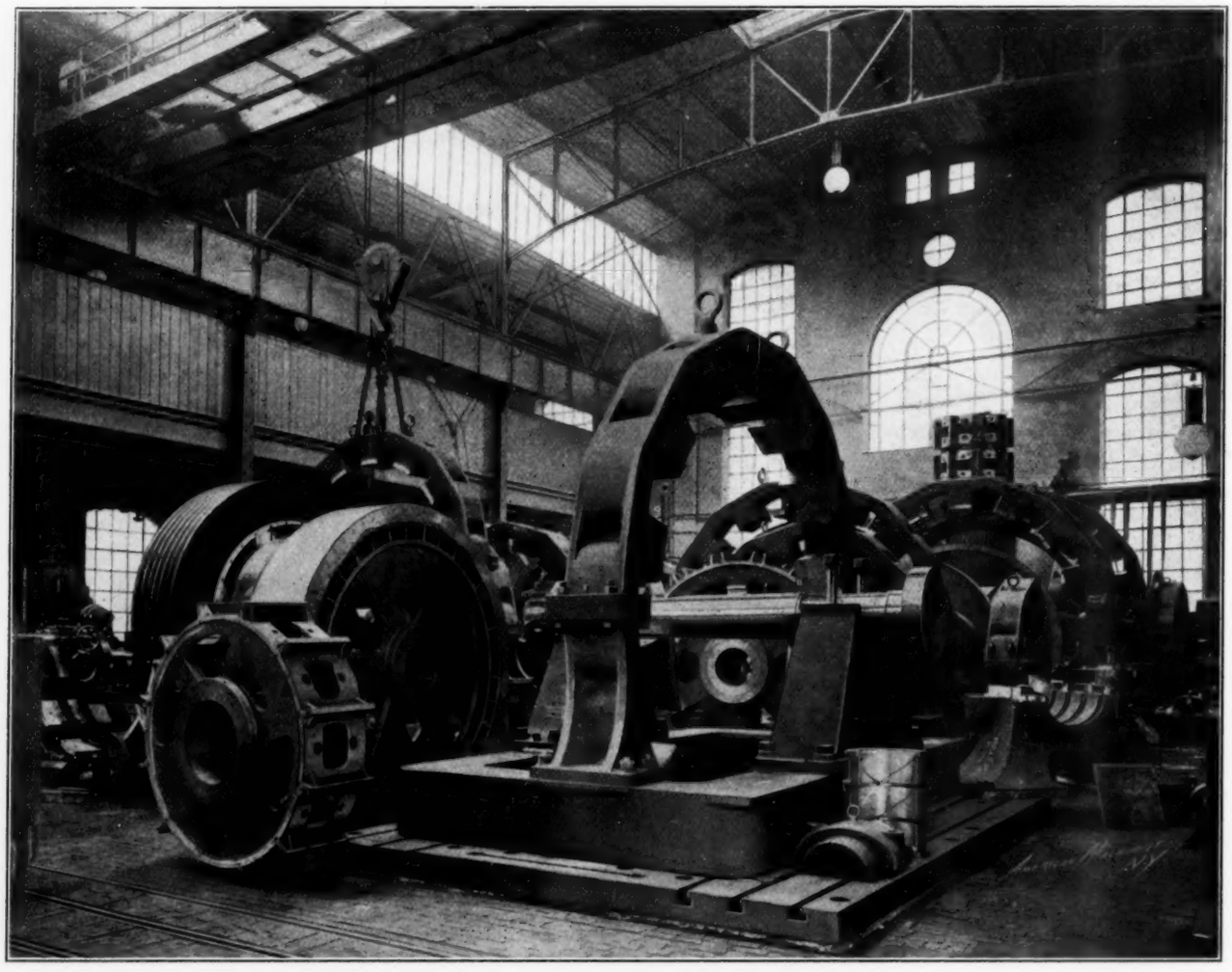


FIG. 4. MOUNTING LARGE DYNAMOS, NUREMBERG.

to comfort the mower and reaper have probably relieved the most human labor for man, and the sewing machine for woman; while the most ingenious device is that which ties a knot in binding twine. There is one thing about this Appleby invention that is remarkable: no one has invented any other way to do it.

At the time of which I speak lumber was sawn by the single sash saw; then came the gang saw, the circular saw and now the band saw and portable sawmill. Altho nearly all of the wood-working machinery was invented in the early part of the last century by one man—Bentham—it has all been perfected and put to use in

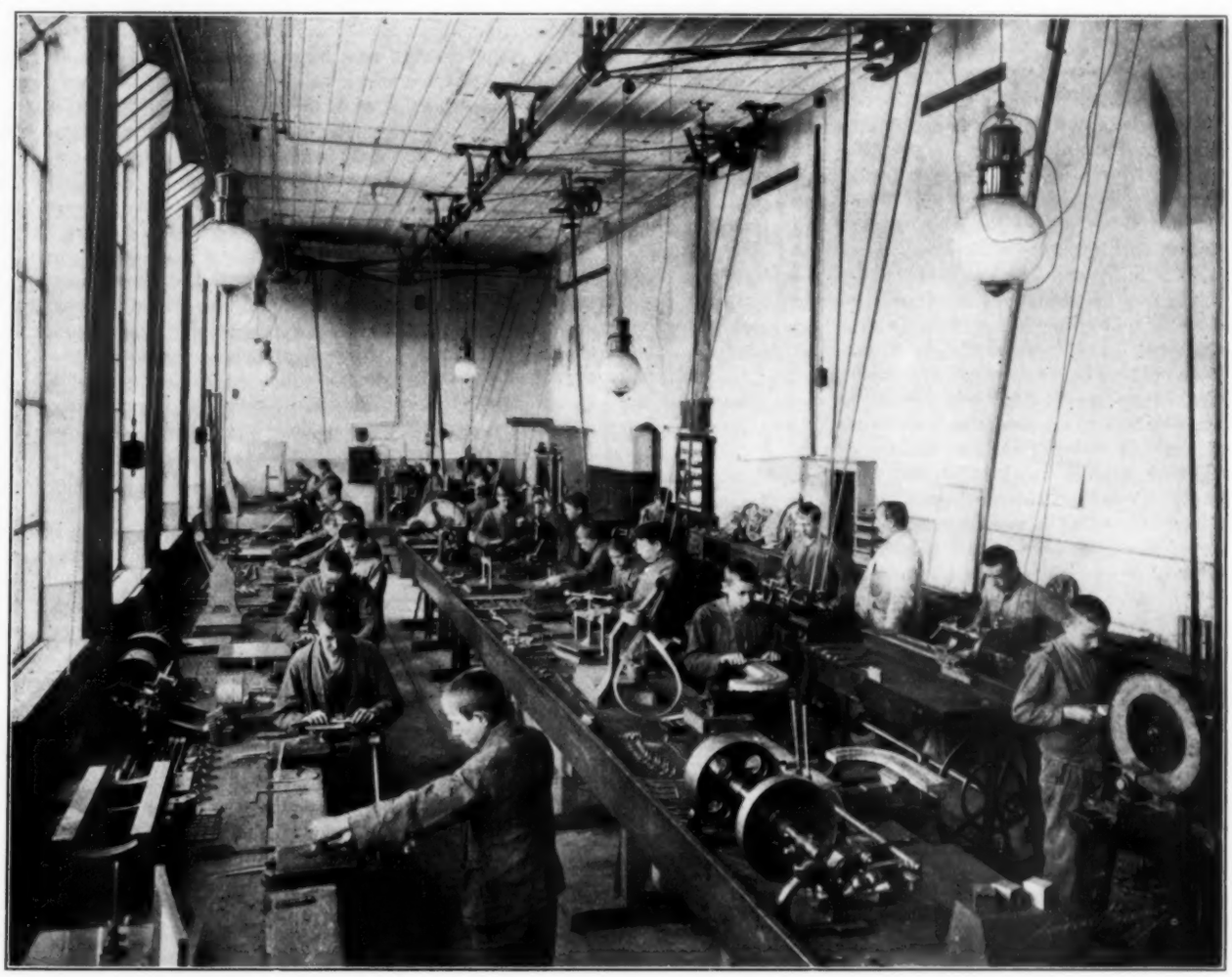


FIG. 5. THE BOYS' SHOP AT THE NUREMBERG WORKS.

my day. The Daniel planing machine, the Woodworth four-sided planing, matching and molding machines, mortise and tenon machines, sash, door and blind machinery, sandpapering machines, dimension saws, trimmers, ballusters, gun stock and oval lathes and devices to meet the "tricks of the trade" innumerable have followed. The most original and ingenious was the Blanchard lathe for turning gun stocks, axe handles, etc., and the most far-reaching the wood planing machine.

Daguerre invented the method of taking likenesses by sunlight. Originally they were on small silvered plates. Out of this grew the photograph, now only a little over fifty years old, then the tin-type, photographs 4, 5 and 6 feet in size; the carbon and bromide prints, half-tone engravings and later photographing in colors, the stereoscopic picture, the stereoscope and lantern and now the mutoscope and moving pictures, which Syracuse genius has helped to perfect. The Frenchman's original work was the father of it all, and was a combination of chemistry and mechanics. The simple mention of the mixture of chemistry and mechanics opens up the story of modern metallurgical advancement.

Telegraphy, which first made a beginning about 1844 and now covers the world, seemed at first an invention for which there was little use, but it has done more in the way of shortening time or of putting more into a man's life than anything else. Out of it has grown the entire range of the practical use of electricity—the galvanometer and Wheatstone bridge, the ocean cable, various batteries, dynamos and motors of a hundred kinds, rheostats, ammeters, voltmeters and electric meters, electric lights, the arc, incandescent, Nernst and Cooper Hewitt, the X-ray, wireless telegraphy, the long-distance transmitter, electric-driven machines, the utilization of the alternating current, constant and variable-speed motors; two- and three-phase currents, electric cranes, rock drills and chipping chisels; galvanizing, electroplating and electrotyping, the telephone, phonograph, megaphone, etc. The horse cars came and have given way to the electric car. Of all these the telephone is a close rival of the telegraph, and the phonograph perhaps the most wonderful. The X-ray and radium are recent discoveries.

In the iron and steel industry there have come the hot-blast smelting furnaces, the Whitwell stove, the rotary squeezer and the Bessemer, the Siemens-Martin and the basic processes for making steel; the steam and various other hammers; the three high, the Belgian, the Garrett repeating and the I-beam trains; the soaking pit, mixers, lifting tables, reversing mills, cold saws, punches, shears, bulldozers, seamless pipe, endless tires, drawn work for all kinds of household utensils, cartridge shells and tubes, chrome steel, nickel steel, self-hardening and high-speed steels, babbitt and other journal box metals, and Franklin metal castings.

The number of inventions in the iron industry alone and their wide influence on

human progress, if set down so that we could fully realize their import, would overwhelm the ordinary intellect. Iron ore is mined and loaded, cars are unloaded by tipping them bottom side up, iron is pigged and loaded into cars without hand labor, or as it comes from the blast furnace it goes into railroad rails without ever getting cold. Each and all are the result of a series of independent inventions, and about every metal product is the outcome of a succession of inventions, nearly all of recent development. To specialize we may trace out the making of bolts and nuts. I have seen hundreds of bolt heads made by wrapping flat bars around the ends of pieces of round iron and welding on, and nuts by bending pieces of square iron into rings and welding their ends together. Now nuts are stamped out at a single stroke, thousands in a day, and bolt heads are upset from the solid bar at the same rate.

I can easily remember when pin heads were made by wrapping a piece of wire around the end of the pin; and how many can realize that inventors worked for years before the lucky man, or the genius, devised the way to upset the head from the solid? The old query, "Where do all the pins go to?" was more easily answered when the put-on heads used to slide down and let the end punch into one's finger.

One who has never seen the monstrous works can form but little conception of the growth of the metal industries, but tipping a car bottom side up to unload it instead of shoveling it out by hand is an index of what has been accomplished.

Railroading, which was in its infancy when I was born, could never have reached its marvelous proportions had it not been for many important inventions, among which are tee rails, the point, or switch, as we call it, that superseded the old switch which, if set wrong, sent the train into the ditch; distant signals, the block system, the link motion for the locomotive, the water scoop, the pivoted truck, the counterbalance and compounding, palace, refrigerating and sleeping cars; the vestibule, automatic couplers, Coffin treated axles and the air brake. With these things speed, safety and comfort have been increased threefold, and over and above the old stage coach tenfold.

Steamboats had made their way on rivers and lakes, but ocean transit by steam, with a single exception, had yet to be. The marine boiler had to be invented. The beam engine has come and gone, and the paddle wheel has given way to the screw, tho one was invented about as early as the other. The step-bearing for the shaft and the engine have gone thru a succession of changes, horizontal, inclined, vertical, trunk, return connecting rod, side beam, single, double, compound, triple and quadruple cylinders; single, double and triple screws, and now we have the application of the turbine, loading and unloading machinery and improvements in nearly every navigating facility, as well as iron and steel construction in the place of wood, water-tight bulkheads, duplicate machinery, life-saving appliances and such care for safety that "going down to the sea in ships" is safer than staying at home. The Cunard line of steamers has crossed the Atlantic for from twice to four times a week for sixty-four years, without losing a passenger and but one or two of its own men.

Implements for the use of an explosive mixture and the explosive mixtures themselves—that is, materials for war, sport and murder, things about which there is a question whether the world would not have been just as well without—have absorbed about as much inventive genius as any other one thing. We had gunpowder and the flint lock musket, which is now a curiosity and a thing I presume some of you have never seen. The invention of the percussion cap and the rifled barrel, the patent muzzle and hair trigger developed the art of marksmanship. The double barreled shotgun, the Colts revolver, the breechloading rifle and the metal cartridge, the repeating firearm, the machine gun for killing men and the air gun and toy pistol for killing boys are all of recent growth.

Implements of war have grown from the smooth-bore cast iron or bronze cannon thru various steps to their present destructive magnitude. We have the rifled bore, breech-loading, steel-banded, wire-wound guns, disappearing carriages and smokeless powder for the army; ironclad warships, the revolving turret, explosive shells, torpedoes and torpedo boats, submarine boats, rapid-fire guns, mines and range-finders for the navy—all elements of destruction. Gun cotton, dynamite and the various high explosives partly compensate by their use in the useful art of mining.

The destruction of life and property in war has only been equalled by the destruction of property by accidental explosions, and of life by murder and of children and grown people killed by guns and pistols when "they didn't know they were loaded."

To say that "in time of peace prepare for war" is the worst sentiment ever expressed in the English language is to set one's opinion against the world, but he who wants to controvert the claim needs to point to a nation that has gone out of existence because it had made no preparation for war, and to that other nation that has been so well prepared for war that it has had no war.

There may have been times in the lives of men when they would have been better off with a gun, but there have been infinitely more times when they and their victims would have been better off if they had had none.

In hydraulics and heat engines the improvements have rivaled those in other lines. The turbine and the impulse water wheel have taken the place of overshot and breast wheels The rotary pump stands by the side of the plunger, direct-acting and duplex steam pumps and has become an every-day affair, and now after fifty or seventy-five years of use of the rotary with a limit of about 50 feet useful lift, it has been discovered that when properly constructed it has almost no limit.

The hydraulic ram, the hydraulic press and jack, the hydraulic engine, crane and accumulator have all been invented within three score years. Hydraulic mining and the Niagara water power plant are among the marvels.

The hot-air engine was born, lived its short life and died; the gas engine has been developed, windmills have taken on a new form and in a way a new life; the utility of compressed air has been developed and includes in its applications the air lock for sinking bridge piers and tunneling under rivers; pneumatic transmission, air hoists and drills, the sand blast and the separation of solids. Steam boilers have taken on scores of original shapes useful and otherwise. The return tubular, marine, water-tube and flash boilers and the growth of the steam engine have shaped the growth of human progress.

After Murdock's invention of the D or common slide valve for controlling the steam distribution for piston engines, and the principle is yet being used more extensively than any other, there was no marked change until Sickles and Corliss introduced their systems. The Corliss system of steam control, now used the world over in large engines and where steam economy is of the first consideration, was one of the most marked changes that has taken place. Surface condensing, compounding or multiple expansion, higher pressures and superheating have each in their turn advanced economy. High speed, tho in no way adding to steam economy, has filled a want and now a return to the earliest form, the turbine, is developing results. Until one learns to what extent the steam engine is doing the work of the world, he cannot realize the importance of these various inventions. All the people in the city of New York could not do the work of the one single 80,000 horse-power plant of the elevated road.

While vast improvements have been been made in the quality of iron, steel and other metals, they are no greater than those in the machines for their manipulation. The engine or slide lathe and iron planing machine had hardly made their appearance in the early thirties, and they bore but a faint resemblance to present practise. The boring mill and horizontal boring machine, the milling machine, the slotter, the screw machine, the turret head lathe and all the forms of emery grinders have been devised and hundreds of automatic machines invented.

True surface plates and straight-edges, the measuring machine and standard gages have been brought out and the full

import of interchangeability has been realized. Means for the local handling of weights have been revolutionized. Self-locking pulley blocks, traveling cranes, the trolley and car track system are all recent. Weighing and testing machines, philosophical apparatus and various astronomical instruments have been greatly improved. Clocks have been improved, the gravity escapement invented; watches have been improved and their construction changed from making to manufacturing and a cipher cut off from the cost of the ordinary movement.

Adding machines have been invented, surveying instruments have been improved, mining has been modified by power drills, high explosives, more efficient ore crushers and stamp mills. The chloride method of separating gold, the diamond prospecting drill, hydraulic mining, the steam shovel for mining, canal and railroad building; the iron shield for tunneling, various machines for handling materials, freight and passenger elevators, the moving stairway, chain and wire rope transmission, the cable railway, transportation of minerals and belt transportation of fine stuff, nearly all replace man or animal power.

The utilization of by-products has been wonderfully extended, far more in other countries than here, except, perhaps, in some places like the Western packing houses, where they say they "save every part of a hog but the squeal." Witness the destruction of sewage here and the utilization of it in England. Other improvements are gas and water supply for cities, improved wagons, velocipedes, bicycles and automobiles with tubular frames, pneumatic tires and ball bearings, steel construction in buildings, metal laths, ribbed and wire glass, more efficient fire protection, slow-burning and fire-proof buildings, steam fire engines, the water tower and fire extinguishers, Portland cement and expanded metal construction, new methods of tanning and dressing hides and new boot- and shoe-making machines, among which are many that are very ingenious; new ways of making leather belts, with a hundred different fastenings, with rope and various chain drives. Among these the most useful are those for protection against fire; the most ingenious, that for sewing on the soles of shoes; while one of the marvels in mechanical perfection is the ball bearing.

Up to within thirty years ago paper was made from waste product, such as rags and straw, but the demand for printing paper outgrew the supply of rags, and the grinding of wood into paper stock was inaugurated, and later the sulfide process of dissolving the wood fiber resulted in an improvement in quality. Originally paper was made a sheet at a time by hand; then came the continuous process, until now it is made in such widths and lengths that if it were not cut for the convenience of handling and transportation, a day's work from one machine would form a single sheet that would cover two tracks of a railroad from Albany to Utica. The number of things made from paper is constantly growing, and includes almost everything from boats, barrels and buckets to bank notes. All of our stationery has been improved in quality. Steel, gold and fountain pens, new inks and tube paints have been invented. Our common schools have been changed to grade schools, the commercial and trade schools evolved, and means of instruction extended to a marvelous extent. The penny post has been inaugurated, the postage stamp devised and the automatic stamp canceller invented.

It was long after my time that the old hand printing press was superseded by the power press. Then came the cylinder press with its reciprocating platen, still using hand-fed single sheets, and then the continuous sheet, printing first one side, turning the paper and printing the other. Later came the single and double web perfecting presses, printing both sides, folding, cutting and delivering two streams of papers ready for the newsboys, and following these came printing in colors, lithographing and blueprinting. Several successful typesetting machines were invented, but owing to difficulties in mechanical distribution they did not make their way into use. Next came a partially successful unitype, in which each type was cast in place and the distribution accomplished by throwing the matter in the melting pot. A half dozen, more or less, attempts were made to form a matrix from which stereotype casts were to be made, but the justifying, correction of errors and displacements in the matrix were fatal. Finally, the linotype machine, a masterly piece of ingenuity, was devised and in spite of prejudice has fought its way into general use, and to-day there are few things produced under such unfavorable conditions that are so near mechanical perfection as the usual specimens of good printing.

It is likely that the most important of these various inventions is the perfecting press, the most ingenious the linotype machine, and the cutest the turning over of the paper by pulling it diagonally across a polished bar and the folding of it by knocking it between two rolls with a dull knife.

The manufacture of woolen, cotton, linen and silk goods has all been changed by new machines and methods. Spinning, twisting, knitting and braiding have been changed from hand to machine work from threads to ropes, and looms for weaving have been brought to a marvelous state of perfection. Garments are cut in lots and clothing is a manufactured product.

No doubt the development of these inventions has been energized by our liberal patent system, but with our liberal system have come many costly if not ruinous patent litigations. Whitney fought in law for several years to sustain his rights against infringers. There was a long legal battle over the Woodworth wood-planing machine. Corliss had two noted suits with Nightingale, Thurston and Sickles over his invention, and the strange part of it was that in one suit he was on one side and won, and in the other his claim was diametrically opposite and he won this also, and before the same United States judge. The judge knew more about the case the second time than he did the first—at least so the story goes.

The sewing-machine inventors had a lively old time in patent suits, until it occurred to some wise head that both sides were losing and the lawyers were getting all the money. So they got together, made a combination and carried on their business in such a way that the small and less perfect machines dropped out. This, too, in a measure was the outcome of the mower and reaper business, tho I do not think the combination was formed until long after the small builders had been worn out in the struggle.

Common sense seems to have dawned on the typewriter business earlier in the game. The bicycle business seemed to be managed differently and, as the automobile is mostly foreign, there does not seem to be any necessity for wasting money in fighting patents.

The practise of law has been greatly modified in recent years, as a recent case shows to some extent. Two farmers were at variance over some trivial affair and went to law about it. Both having strenuous natures, with plenty of that American grit we are so boastful of, kept on until one lawyer owned one farm and the other lawyer owned the other.

The practise of medicine has changed from cut and try to a science. The microscope has been perfected, the microbe discovered and the benefits of antiseptics and anesthetics discovered and used. The invention of tools, implements and apparatus has revolutionized surgery and dentistry, while "hell fire" and "infant damnation" have been pretty well eliminated from religion.

This thousand and one inventions that I have enumerated is but one thousand of six or seven hundred thousand that have been patented in this country, and when we realize the magnitude of the list, the greatest of the inventions dwindles to a simple contrivance, the greatest of inventors shrinks to a small unit, and we who have done little things are but ingenious microbes.

Let us take a brief review of what invention has done during the allotted span of a single life:

From the age of tallow dips to electric lights; from the fireplace to ranges, furnaces and steam heat; from the log-house and bare wall hovel to palatial dwellings, from pork and potatoes to the luxuries of life.

From the farmer with his spade and shovel, axe and flail, sickle and scythe to

his plows and cultivating machinery, mowers and reapers and threshing machine.

From the carpenter with his broad axe and adz, hand saws and planes, 2-inch auger and mallet and chisel, to sawn timber, machine-dressed lumber and stock joinery, from 16 hours to 8 hours and from 80 cents to from 3 to 7 dollars a day.

From the blacksmith with his hand bellows, hand hammer and sledge, to the power blower, steam, drop and power hammers, and so with every branch of human industry. Machinery takes the place of hand labor, the hours of labor have been lessened from one-quarter to one-half, and wages have been advanced in a much greater proportion.

Railroads have superseded the stage coach, so that in the place of weeks, which it took a man to go from end to end of the State, he can now go in days from ocean to ocean, and freight can be carried for cents where it formerly cost dollars.

Hand-set type and the hand press that ground out the little newspaper have been superseded by the linotype and the perfecting press that turns out papers of mammoth size by half a hundred thousand an hour.

The doctor, the lawyer, the minister and the author double their fields or cut down their drudgery by the phonograph and typewriter, and the business man adds a cipher to the amount of business he can do in the same time by the aid of the telegraph, telephone and stenographer.

These great changes, ten times as great as were ever before evolved in the same length of time, are the results of invention. A few the happy thought of a genius, many the result of the prolonged study and experiments of the inventor, and many more of the diligent delving of the plodding mechanic.

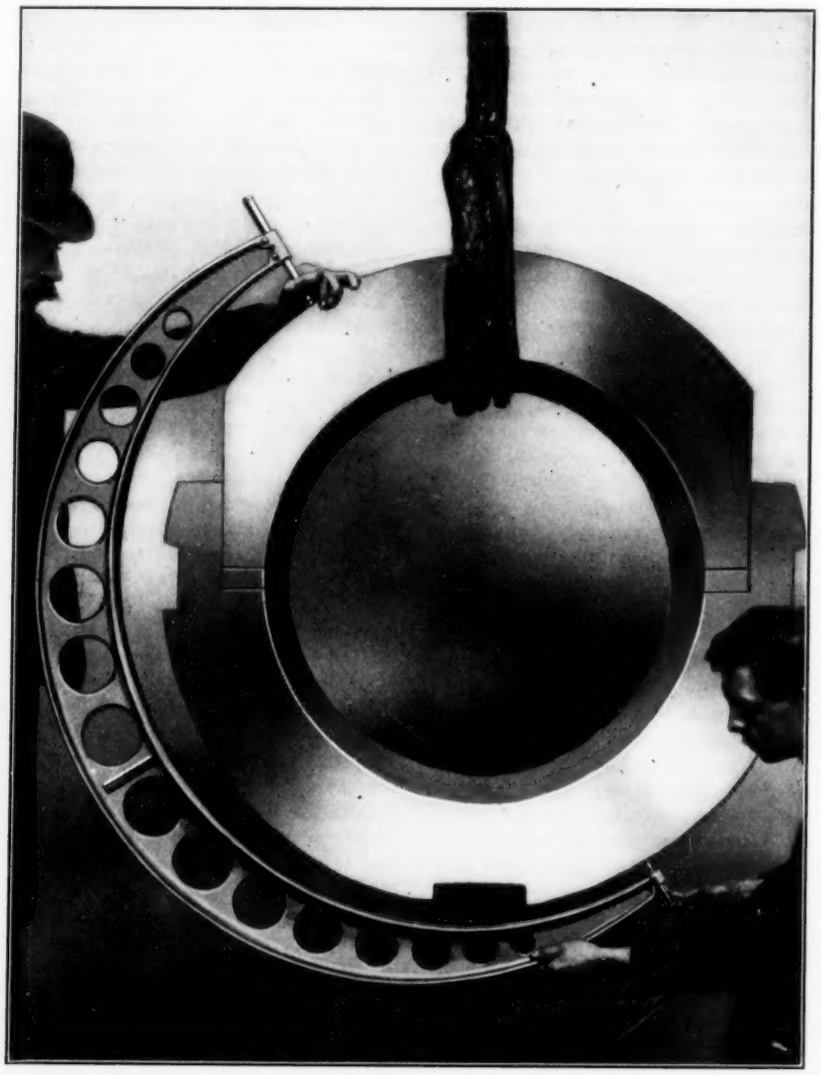


FIG. 1. LARGE MICROMETER CALIPER IN USE.

An old mill picturesquely situated near London is employed in grinding sawdust —brought in large quantities in vessels from Norway—into flour as fine and soft as that of the purest wheat. The wood flour is not used as an adulterant, but is an important element in the manufacture of linoleum. It is more than probable that many other uses can be discovered for this finely pulverized wood. When diffused in the air it is explosive; why not therefore a wood-dust engine?

Large Micrometer Calipers at the British Westinghouse Works.

BY WM. S. ROWELL.

The article at page 1013 describing gaging and measuring instruments employed at the Westinghouse Machine Company's works, was interesting to me for many reasons. Certainly all who are interested in measurements in engineering works owe something to the Westinghouse Machine Company and to Mr. Thomas. Perhaps you would be pleased to place before your readers a partial description of another set of large aluminum zink calipers, of which one size is shown in Fig. 1, that may, in a sense, be said to be the descendants of those illustrated in the article referred to, having been made and being in use in the Manchester works of the British Westinghouse Electric & Manufacturing Company, Limited.

No special novelty of design is claimed. The sizes range from 12 to 48 inches each size up to 36 inches covering 4, and above that size 6 inches each. The part of the design that consumed the most time was the adjustable tail spindle (anvil), as the shortcomings of the 10-threads-per-inch and half-nut clamp method had been noted. The method employed is much more expensive, but still not wholly satisfactory, the principal trouble with it being to secure for it proper use, which is part of the trouble with any tool that is used by many.

The tail spindles are tool steel ground to 9-16 inch diameter, each clamped in a reamed 9-16 inch hole in tail end of micrometer frame by two 14-24 screws provided with nurled nuts, as shown in Fig. 2. This provision is ample with proper use. The tail spindle shown in Fig. 3 is hollow and provided with a 17-64 inch rod thru the center, the hardened, ground and lapped end of which is the anvil. It was made 17-64 inch, because that is the diameter of the commercial micrometer screws used at the head of the micrometer frame. The accompanying sketches will plainly show the construction of tail pieces and method of clamping. With this tail spindle ready adjustment to zero is secured.

While these micrometers were being planed and made, no method of taking measurements with the larger ones had been decided upon. The chain and spring-supported stirrup leave much to be desired. Before the first measurement was taken with a large one, the method shown in Fig. 1 with the anvil at the top had been decided upon, and it instantly proved its adaptability to the most delicate measurements; one .0005 inch variation in size being as readily detected as it would be with a 1-inch or 2-inch micrometer.

The advantages of this method are obvious. The hand is at the point of contact; it is also at the screw to adjust it while feeling for contact; it is also not on the frame distorting it with warmth; but the greatest advantage lies in the fact that the micrometer hangs in stable equilib-

rium. The workmen say: "It comes up to the work itself," not wanting to leave the highest point of the work. The only care necessary to secure this advantage is to place the anvil at the proper hight, which hight, after the first few trials, is generally guessed correctly within an inch, the necessary adjustment taking but a few seconds.

By the half-tone the I-beam section and general outline of the frame will be seen. While there is a heavier section near the

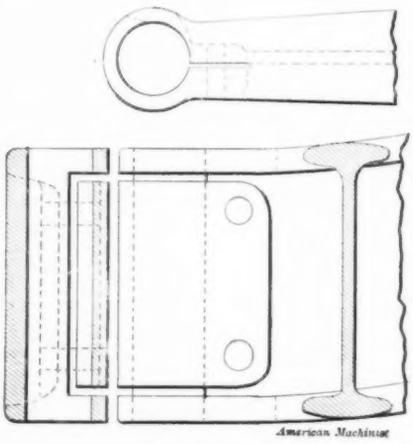


FIG. 2. METHOD OF CLAMPING THE ANVIL.

tail than the head, the fact that the instrument is to be used in all positions kept out any tendency to follow the well-known Thomas form.

Of course strict adherence to the principle of setting the micrometer while it is in the same position and supported in the same way that it is to be while taking measurements, is necessary. Checking back on the measuring rod after taking an important measure is to be insisted upon. My own use of the suspended method shown in the photograph has been so satisfactory that I feel it cannot be recommended too highly. It not only gives better results than any other method known to me, but it requires no "tackle" except a helper's finger or thumb placed against the work at the right spot. While this method does not secure the possibility of one man taking a measure by himself, when using the largest sizes, the helper's part is an inert part; any other support that could be readily attached to the work and movable would do as well as the helper's finger or thumb.

Manchester, England.

Echoes From the Oil Country.—Reducing Friction.

There was a new draftsman and designer in the place. No, No; that is not right. That is not what I intended to start out to say. There had been men there who "got up" things, and there had been men who made a drawing once in a while, but that was not their chief end in life. They made patterns, etc.

This man was not new in the sense that he followed another one of his class. He stood in a class by himself. As far as the shop was concerned he was new. They had never seen anything like him before, and, equally true, they have never seen anything like him since.

It did not take a very extended experience with him to convince any close observer that the stories about his having been educated abroad, and about his father having been one of the nobility, were true. One only needed to watch his profound manner of greeting the proprietor, the shade of difference in greeting the head of the office, his genial but unceremonious manner toward the superintendent, his offhand air toward the foremen and his careful condescension toward the workmen, to know that it had never been learned in the air of the Allegheny mountains. If one still had doubts on the subject, those doubts could not long retain their places after he had been heard to give orders to the patternmaker. They were positive, and did not admit of being questioned any more than would the orders of an officer commanding an army. It is the business of some people to give orders, and it is the business of others to obey. Sure.

It might seem strange that such a man could be unpopular when he was *so* willing to let others know that he was chock full of knowledge and of good breeding. Perhaps he was not unpopular when he was among his *equals*, but the *boys* had no chance to see him there. His experience in this country had been very limited, and it did not seem to be very reassuring. The people acted so differently from what he had been used to that he evidently did not know how the material worked on might act.

One of his first jobs in this shop was the designing of a small crane. This crane was to handle a load of not more than 2 tons, and was to stand in a brick building; but for all of that he seemed to think it necessary to make sure of the walls and foundations of the building, and to go into an extended research as to the exact grades, properties and peculiarities of the material that it was desired to make use of. After this it was important that the American factors of safety be looked into, and something be learned of the formulas and their derivations as used in this country. As this work was to be built and used in America, and of American material, it should be figured out by American formula, so that there could be no mistake.

"All things come to those who wait." Finally a really beautiful drawing found its way into the hands of the patternmaker, and he started on the patterns. Now, when anything is wrong, the one who discovers it should go to the person who is at fault and try to have it straightened out with as little trouble and publicity as possible. Some people do not take it kindly when another dares to criticise their work, and when this is known sometimes the work suffers, and sometimes any changing required is done in a roundabout way. Sometimes, too, a very able body will make a slip which seems ridiculous to others, and the knowledge of it will be passed all over a shop because at some former time he has sat down rather hard on some mistake of a shop man.

The shop foreman was passing thru the pattern shop when he was called to by the patternmaker: "Have you got time to stop a minute? I want a little information."

In more than one shop this machine shop foreman had found that others liked to make use of him to straighten out things when there was a mix-up, and as he liked to see things going smoothly he generally did his best to get matters untangled. Perhaps the fact that he was always ready to spend a little time trying to keep them from getting tangled had

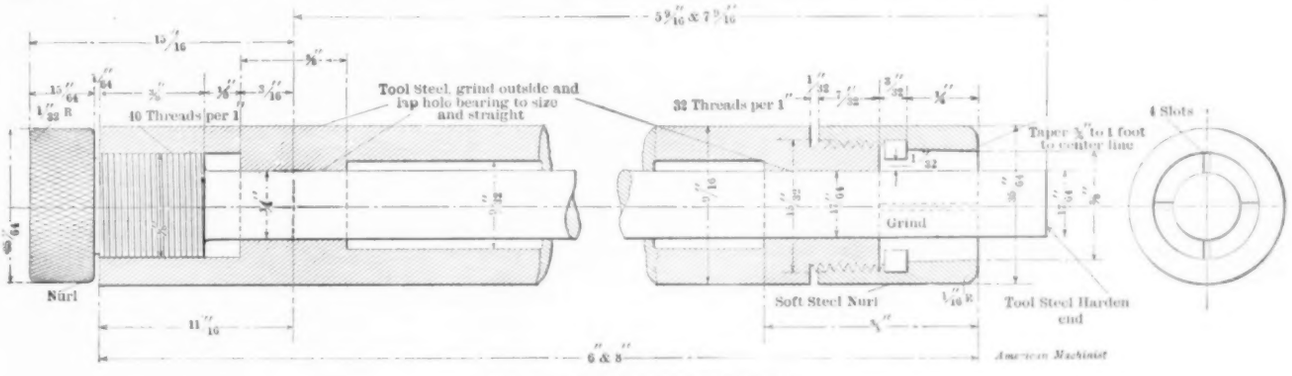

Tool Steel, grind outside and lap hole bearing to size and straight
10 Threads per 1"
32 Threads per 1"
4 Slots
Taper ⅛" to 1 foot to center line
Grind
Nurl
Soft Steel Nurl
Tool Steel Harden end
American Machinist

FIG. 3. CONSTRUCTION OF ANVIL.

something to do with his being so confided in when the tangles did occur.

It may be explained that the patternmaker was quite a good draftsman himself, and he looked on the employment of the other man as somewhat of an indirect reflection on his ability in that line. The poorer he found the other's work to be the more of a reflection he considered it. As the boys express it, "He was a little sore on that point."

"Certainly I can stop. I have all the time there is. What is the excitement?"

"Nothing at all. I am after a little information. That 'guy' in there," nodding toward the drawing room, "brought me out some drawings for the castings of a crane. The Old Man said some time ago that there would be some crane patterns to make. Do you suppose he wants me to work to them?"

There was an undertone to the question that told of something not on the surface.

"I should think so. Do you know of any reason why you should not?"

"No. Not if he wants them that way. Every size and every line on the drawings is very nice and clear," and the subject seemed to be dismissed, and the foreman made a move to leave, when the patternaker said:

"Would you mind lending me your micrometer? I need one that will measure up to about 1½ inches."

"I will lend you the one I have, but it will only measure up to 1 inch. But what on earth do you want a micrometer for, anyhow?"

"I don't know how I am going to make the patterns those drawings call for without one." And he tried to speak without showing any feeling in the matter.

"Let me see the drawings a minute." And a very brief inspection showed that they were actually figured in thousandths of an inch. They were very awkward numbers, too, that would not reduce evenly to any scale sizes.

"I should take the nearest scale sizes and make them full or scant the balance as near as I could guess, and let it go at that."

"Would you!" It was not a question, but a sarcastic exclamation.

"He," with a nod toward the drawing room, "will be very likely to come out and check the patterns over, and, when he found out how far off I was then, where would I be?"

"I don't think there is any danger of that."

"You don't, eh? Just look at that, will you."

Sure enough, there was a place where one side of a piece was figured to be made one thousandth thicker than the other. Evidently that was as near as the figured sizes would divide without going into smaller ones, and even inexperience would not stand for that. It was of no use trying to explain anything to the patternmaker. He was "mad." Even the foreman's story of the blacksmith and of the machinist who used to insist on giving his orders in fine sizes did not cool him down.

"You can talk all you have a mind to. I don't care a damn. If a jackass is hired to send in such sizes it isn't my fault. I'll work to the sizes he furnishes or I won't work. I've worked a long time at the business, and this is the rottenest deal I ever got."

The foreman saw that the patternmaker was working himself up to the point where, for the time being, it would seem that all the trials of his life were the fault of this particular job. While in that frame of mind he might say or do something that his pride would not let him undo later. He was a good man, and it would not pay the shop to lose him because of such a thing, neither would it pay him to quit because of it. The foreman took the drawings, remarking: "Perhaps he made a slip and put his figured sizes on, forgetting to turn them into rule sizes. I will see."

Perhaps he would get into trouble with the man on the other side of the door, but it looked like trouble on this side if he didn't do something.

"Good morning. I will have that crane to build, and so I was looking over the drawings. You make a very nice drawing. If I could make the crane look as well as you make the drawings, it would be something to be proud of. There is just one thing about them that is apt to give us trouble. You see, we are not used to doing very fine work in the shop and I always try to have things make as easy for myself as possible. A good many of us can't read decimals any too well, and it would be an accommodation to me if you would change these sizes to common fractions."

"But, sir, they will not convert into the vulgar fractions with exactness."

"Won't they, indeed? Well, in that case there is nothing left for it but to have you turn them into the nearest even fractions. Your superior judgment will tell you whether it is safe to make one a trifle small or to go up quite a bit larger when there is not much difference. If we tried it down in the shop there is no telling where we would end, and when we got thru the crane would not be like the drawing."

He knew that all draftsmen are sticklers to have the product *exactly* like the drawing, and, as if a new thought had struck him, he added: "Of course we do not use all the sizes, but it would look better on the drawing if they were all alike. If it is not too much trouble to change the patternmaker's sizes, too, it would keep things uniform."

Not only were the sizes changed, but they were kept in eighths, and sixteenths. This man was willing to try to keep within the capacity of those who had to do the work as soon as the situation was clearly understood by him, altho, as he truly stated, "You must train your men if you ever expect to do really good work."

The patternmaker was surprised to see how quickly the figures were changed. He might not have been surprised to have seen his friend helped out of the other room. In his temper at the time he might have felt some disappointment because he did not see it.

Some people might argue that this matter was not settled in the right way, and that the foreman of the machine shop had no business to waste his time as he did. Bless you, he had often wasted more time removing some cause that made some part of the inanimate machinery run hot. He went to the other departments whenever called for, and also without being called if he thought things were not going as they should, and everyone thought that was only part of his business, and he did not feel like making any fine-haired distinctions. To his mind there were two kinds of machinery around: live machinery, and inanimate machinery. The live machinery was by all odds the most important, but the very poorest machinery that could get into any shop was the machinery that could be alive but was not; he did not wish to remove the spirit of any of it.

Every piece of machinery should be used in a place where the surroundings harmonize, and the draftsman and designer here told of is now somewhere else.

W. Osborne.

The Technical School as the Royal Road.

The old statement that "There is no royal road to learning" is untrue. The man of affairs has come to understand that *the technical school is a royal road to learning*, a shorter road, an easier road, thru a more beautiful landscape, and in equal time attaining a broader outlook.

A man with the earnestness and persistence of John Brashier, the strong purpose of John C. Hoadley, the rugged common sense of Edwin Reynolds, the strong, kindly heart and quick intelligence of John Fritz, or the genius of Edison, may reach an equal hight by a longer and more arduous road, and, like the athlete, increase his strength and harden his endurance in the greater effort; but the royal road of the technical school, in its four years may, from its small group of a hundred, gathered part by chance and part by process of natural selection from more than ten thousand school boys, bring perhaps ten or twenty to the point that otherwise not more than one or two or three could hope to reach in twice these four years.

The technical school is not exclusively for the brilliant man. Much of the world's best work is done by the slow-moving intellect, to whom the good Lord has given the greater treasure of persistence, of steadfastness, with enough of imagination to feel what is concealed within the cloud on yonder difficult and distant hill.—*John R. Freeman, at Case School of Applied Science.*

Experience With the Premium Plan.

BY "TAP."

Some years ago the writer left the iron trade to enter the employ of a wholesale jobbing house that was about to undertake the manufacture of window shades. Only special order work was attempted at first, and it was carried on in a very primitive way; but later on as the business increased more help was engaged and it was decided to handle the staple or cheaper grade article. This necessitated improved methods and the employment of boys and girls in order to meet competition. With the employment of boys and girls came trouble in their management and, when it was desired to reward the industrious ones with an increase in wages, the drones were not slow in asking for a like advance, resulting often in a change of help—not a very pleasant thing for the man in charge.

Cost of production was not to exceed a fixed figure, and it was difficult to meet it under the scale of wages then paid. Piece work was suggested from the office, and its adoption brought about a small-sized strike and a possibility that we would be compelled to drop the cheaper class of work.

About this time I read in the AMERICAN MACHINIST a suggestion of the Premium Plan, and it seemed to me the most feasible solution of the problem then before me. After careful consideration, I set a basis of work required at the minimum rate of wages paid per hour, being careful not to set the work too high, and yet to safeguard the firm against loss. I then went around the shop and informed the employees individually of the proposed plan and had no difficulty in convincing them that they could, with a little effort, increase their wages much faster than under the old system.

Fig. 1 is a portion of a weekly time sheet which shows the amount of work done, the time consumed and cost of each part or total cost of labor on a given quantity. The upper figures in each section indicate the hours and minutes, and those below the quantity. The wide center column shows totals for the week, the next the total time consumed, the next the minimum quantity in dozens per hour, the next the wages paid at minimum rate of five cents per hour, and the last the extras earned at the rate of one cent, or one-half a cent per dozen over the minimum quantity required per hour. It will be readily seen that, by adding together the items shown in the last two columns, we obtain the figures under the head of "Total Earnings," or, by adding vertically, we have the results of the week for each tem as specified at the heading.

WM. VOLKER & CO.

Kansas City, Mo.

Mtd by_____

Sewed by_____

Wrapped by_____

Wrapping_____ Doz.

Stitching_____ Doz.

Fringing_____ Doz.

Insertion_____ Doz.

Mounting_____ Doz.

Cutting_____ Doz.

American Machinist

FIG. 2. WORK TICKET.

Small work tickets, shown in Fig. 2, are furnished and coupons are torn off by each party as he completes his part of the work. These tickets are turned in every morning to the foreman, and show the work done the preceding day, which is entered on the weekly time sheet.

Another difficulty presented itself in the matter of special order work, and, as it was not easy to regulate it as piece work, we had for a time been paying by the hour a sum equivalent to the earnings of the boy under the Premium Plan, but we soon found ourselves up against the old trouble and finally concluded to act upon the face value of the bill.

To compensate for the minimum wages paid, one dollar is deducted from the face of the bill for each hour consumed and the boy is then given one per cent. of what remains of the bill as a premium. Thus, should he consume ten hours for a bill of goods amounting to sixty dollars, ten dollars would be deducted from sixty, leaving fifty dollars, and he would be paid one per cent. of this, or fifty cents as a premium, which, added to his wages of fifty cents a day, would make his total earnings one dollar a day. Should he consume eight hours he would be paid a premium of one per cent. of fifty-two dollars, or fifty-two cents. His wages for that eight hours would be forty cents, making his total earnings ninety-two cents for eight hours, or $1.15 per day.

NAMES	CLASS OF WORK	Sat.	Mon.	Tues.	Wed.	Thur.	Fri.	TOTAL	Time	Min.	Wages	Extra	TOTAL EARNINGS
H. Jones	Cut Shades,	1 10 / 32	2 30 / 61		1 45 / 55	3 20 / 81		229	8 45	5	44	93	$1.37
"	Cut Rollers,	1 45 / 10						10	1 45	2	09	07	.16
"	Mounted,	2 00 / 10			0 20 / 3	1 50 / 15		28	4 10	2	21	20	.41
"	Stitched,	0 35 / 10		2 10 / 39	0 15 / 3		2 45 / 45	97	5 45	5	29	68	.97
"	Fringed,	2 10 / 10			0 45 / 3			13	3 25	2	17	06	.23
"	Wrapped,	1 15 / 10			0 20 / 3		5 10 / 45	58	7 15	3	36	36	.72
"	Bundled	0 35 / 10						10	0 35	5	03	03	.06
"	Cut Spol. Orders,		3 10 / 33 14			2 20 / 29 08		62 22	5 30	$1	27	57	.84
"	Mtd. " "		4 20 / 33 14	6 35 / 54 10	4 25 / 41 30	2 30 / 35 15		163 50	17 50	$1	89	146	2.35
"	Jobbing			1 15	2 10		1 35		5 00		25	25	.50
											3.00	4.61	$7.61

American Machinist

FIG. 1. PORTION OF A WEEKLY TIME SHEET.

Under the old plan we used to engage a boy at three dollars a week and, if he showed a disposition to work, he was advanced about fifty cents about every four or six months, or promoted to higher positions in the house, according to his ability. It is almost needless to say that many were called but few were chosen, and oftentimes a worthy one was hindered in his efforts

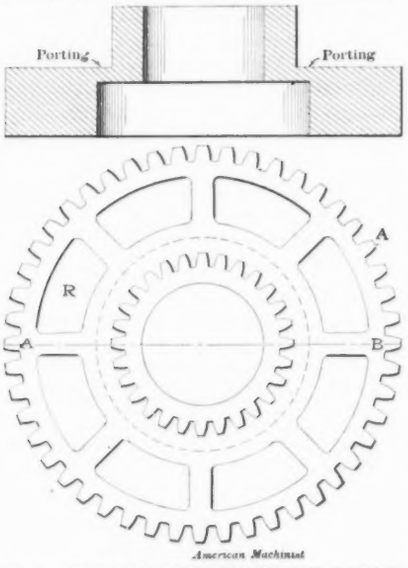


FIG. 1. COMPOUND GEAR MOLDED ON A STRIPPING PLATE MACHINE.

by the annoyance or interruptions of others.

The average amount of work turned out did not warrant increase in pay. Take, for instance, mounting shades on rollers, of which the average quantity was about thirty-five dozen per day, and when new help was employed it took much of a foreman's time for weeks in giving instructions, and frequently the work had to be turned over to more experienced hands to be perfected.

When the Premium Plan was introduced it was very amusing to watch the little fellows struggle and compete with each other to see who could earn the most money. It was no longer a task for the foreman to keep order, and his attention was only required to see that work was properly done, and new ideas suggested themselves as things progressed.

It will be noticed that in this particular part of the work two dozen per hour, or twenty dozen per day of ten hours, was set as a minimum quantity, which, at five cents per hour wages, makes a cost of two and one-half cents per dozen. But, as the boy now turns out six dozen per hour, the cost is only one and one-half cents per dozen, and the boy earns nine cents per hour. Besides the saving in cost, there is no longer any annoyance, and we are spared the trouble of changing help. Employer and employee are satisfied and perfect harmony prevails.

I have been sent to open a branch house in another city which is run under precisely the same conditions, and with like success.

Molding a Compound Gear On a Stripping Plate Machine.

BY H. L. F.

There is one known method of machine molding by which any pattern can be mounted and a perfect mold can be made from it; yet it would not be wise to apply this method in all cases, as it is too expensive. It is commonly termed the stripping-plate method, and while it has been known and practised for over a quarter of a century, it is only in the last few years that it has been shown to be a practical and profitable method of molding.

Modern machine tool building methods have done much for the molding machine. They have made it possible to get more accuracy in the construction, a point vitally essential. A molding machine should be strongly constructed, rigid in all parts, and all working parts should be hardened and accurately set, and when placed in a foundry the machine should be in the charge of a capable mechanic, to see that it is not abused.

In the drawings I show a compound gear, Fig. 1, mounted on a drop-plate machine by the stripping-plate method. There are two types of machine in which the stripping plate is used. One is a drop-plate machine, where the pattern, by the manipulation of a side handle, strips down thru a plate cut to the shape of the pattern. The other type is where the flask, the sand and the stripping pieces are raised from the patterns. The machine of the latter type is more costly, yet it is cheaper to mount patterns upon it, and, as a general rule, air power is used with it, while the drop plate machine is hand operated.

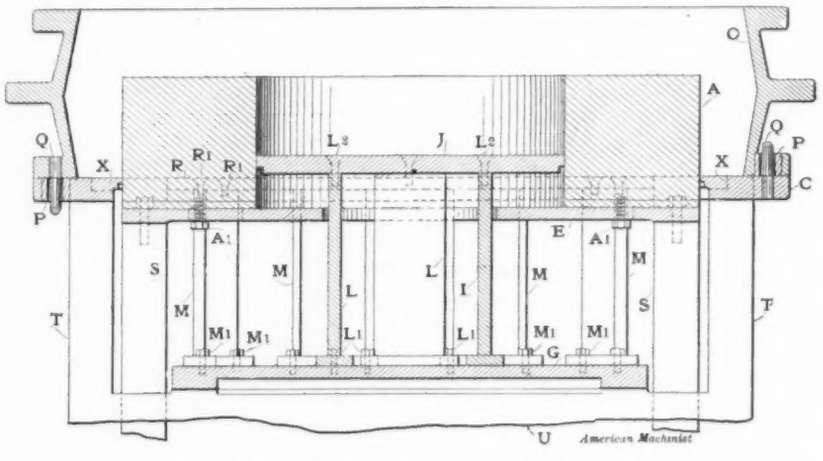


FIG. 2. THE MOUNTING OF A PATTERN FOR THE DRAG.

A gear can only be machine molded successfully by the stripping-plate method, therefore I show a compound gear mounted as it would be if there were only the one size to be made; but if there were two or more sizes of different numbers of teeth, then the stripping plate should have the center cut out and a step recessed in the face of the plate, as shown in dotted lines at *X* in Fig. 2. In this recess is to be set a changeable brass ring, so cut it out large enough for the largest size gear to be made. Into this recess set a turned brass ring for the special gear to be molded and secure it with eight or ten flat-head screws tapped into the permanent machine plate. The bore of the inserted brass ring should be the same diameter as the bottom of the teeth in the gear, and the teeth should then be cut to just slip over the gear.

In Fig. 1 the parting line is indicated, and all above this line is made on the drag machine while all below it is made on the cope machine. So first make two separate wood patterns, one of the cope section and one of the drag section, making them extra deep so that they will protrude thru the stripping plate and rest on the pattern plate and then have as much pattern above the plate as there is from the parting line up or down on the gear to be made. Make these gear patterns as blank rings and then have a good gray-iron casting made from each. Have the castings thoroughly cleaned and send them to the machine shop to be finished to size and have the teeth cut. Next make a pattern of a stripping plate. As a general rule, stripping plates are made very rigid to prevent springing, but in this case I show it quite light, as there is very little plate left to spring after it is all finished, and, if it is planed true on both sides, then the molding machine will, with the aid of the screws, bring it to its true shape, even if it should chance to get sprung while not in use. One object in having light plates is to lighten the work of the man who may have to handle them. The pattern for this stripping plate should be made blank, no opening for the gear being allowed. On two sides directly on the center line and opposite each other, there should be ears for the flask pins. Have two good castings from this pattern planed on both sides to the desired thickness. Next make a pattern of the pattern plate *E*, Fig. 2, and *F*, Fig. 3. This plate is to be finished on top and on two side strips on the under surface. In the center of this plate is a hole the same size as the center thru hole of pattern *B;* see Figs. 1 and 3. This pattern will do for both the cope and the

drag machine by making eight holes thru it for stools *M*, Fig. 2. These stools are for the openings *R*, Fig. 1. Get two castings of it and have them planed to the necessary thickness; then make a wood pattern of the stool-supporting plate *H*, Fig. 3, and *G*, Fig. 2. This plate is a blank plate with finish on both sides. Get two castings and have them planed on both sides. Next make a pattern of the stools *M*, *L*, *K*. One pattern will do for all, but as these stools are in three different lengths the pattern should be made first for the longest one, having as many made of it as are needed, then cutting the pattern to the next length, and so on. These stools are finished so that all of each set are the same length. Now make a pattern of the stool stripping plates *J* Fig. 2, *I* Fig. 3. One pattern will do for both if made to the largest size, a finish being allowed on both sides and edge. Get two castings, have one *J* finished to fit the inside hole of pattern *A* and one *I* to fit the inside hole of pattern *B*. The finished edge shape will be seen in Figs. 2 and 3. Now make a small wood pattern to the shape of *R*, Fig. 1, allowing machining on top and bottom and a file finish on the edges. Get eight castings. See *R*, Fig. 2, for a better view of it.

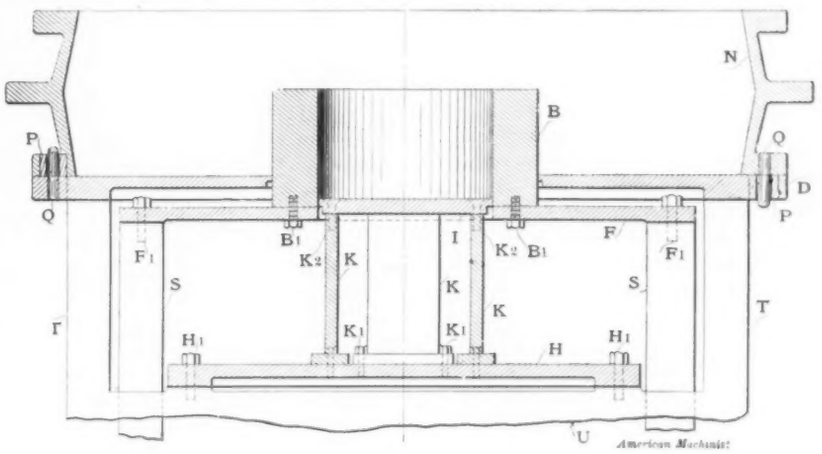


FIG. 3. MOUNTING OF COPE PATTERN.

The plates, stools and patterns being made, proceed to finish them. Lay off center lines at right angles on both plates and scribe a circle on the face of plate *P*. Clamp the finished gear true with this circle with a tooth central with a line and scratch the outlines of the teeth on the plate. Remove the gear, clamp the plate to a face-plate, cut the center out to the diameter of the bottom of the teeth, then turn the plate over and cut out the under side to the outside diameter of the teeth, leaving the plate where the teeth are to be cut out not over ¼ inch thick, as all of this stock has to be cut out to fit the gear. Drill out most of the stock at the tooth spaces and file the remainder until the gear will slip thru freely, remembering that the neater the fit the cleaner the mold will be. The parting line can be scratched on the teeth of the gear, and then with a file give each tooth a slight draft from the parting up, this draft to be only four or five thousandths of an inch in its whole length. When the teeth of the drag stripping plate are finished, take the cope stripping plate and do the same.

Now drill both stripping plates, both pattern plates and both stool-supporting plates to fit the machine. This drilling is generally done thru jigs furnished with the machine. Now set the drag machine plates on the machine, slip the gear in its place and scratch the outline of the inside hole or bore of the pattern *A*, Fig. 2, on the face of the pattern plate *E*. Remove the pattern and pattern plate and locate and drill in the pattern plate four holes for the screws *A*1. Set all the finished parts back on the machine, then take the stool-stripping plate *J* and set it in place, blocking it up from the pattern plate below. Measure the distance from the top of gear pattern *A* to the face of plate *J*, adding to that the thickness of plate *J*. Now find the distance from top of gear pattern *A* down to the top of the pattern plate *E*, subtract the first found measure from the last and this will be the length for the stools *L*, so make four of them to that length. Drill two holes in the base of each stool *L* for the screws *L*1. Locate them on the stool-supporting plate so that their ends will enter the center hole of the pattern plate *E*, as shown in Fig. 2. Scribe the location of holes in base of stools on face of the stool-supporting plate; center-punch these places and then determine the length of the stools *M*. The upper ends will come below the parting line of the pattern *A* in holes *R*, Fig. 1. Drill two holes in each of the eight stool bases for the screws *M*1; set the stools in place on the stool-supporting plate so that their upper ends will come about in the center of the holes *R* in pattern *A*, and while in this position scratch the outlines of the holes in the bases of stools *M* on the face of the stool-supporting plate. Drill and tap the stool-supporting plate for both stools *L* and *M* and screws *L*1 and *M*1. Put it back on the machine, fasten the stools *L* and *M*, then red lead the top faces of the stool *L* and *M* and set in plate *J* and the small plates that were made to fit in the holes *R*. Lower the gear by means of the lever at the side of the machine and then these plates can be lifted out or off the ends of the stools *L* and *M* one by one, with a designating mark put on each plate and stool. Now in the centers of the red-lead spots that will show on the under sides of the plates drill and countersink holes for screws *L*2 and *R*1, Fig. 2. Raise the gear up thru the stripping plate, set the pieces or the plates in place again and scratch the outlines of the holes just drilled on the ends of stools *L* and *M*, then drill and tap the stools for the screw to be used and put them in place on the machine.

Take the stripping plate *C*, Fig. 2, from the machine and lay it on the bench, take a piece of wrought iron, 3x1 inch and long enough to reach a couple of inches past where the flask pins are to go in it; have it planed on each side. Lay off on it the flask pin and bushing location, then drill it for a bushing *P* with a center hole large enough to take in the bushing for the stripping plate. Make two tool-steel bushings to fit the hole in the jig, one having a center hole in it the same size as the small end of flask pin *Q*, and the other to the size of bushing *P*. Locate the flask pins and bushings in the ears on stripping plates *C* and *D*, strap the wrought-iron jig to the face of the stripping plate, drill the holes in the stripping-plate ears and put the flask pins and bushings in place. The drag machine is now finished, with the exception of the flask.

The cope machine, Fig. 3, must now be finished, and as both patterns have been finished and both plates fitted to the teeth of the gears, set them in place on the machine and proceed to locate the holes for the screws *B*1 as was done for the screws *A*1 in the pattern *A* and then fasten the pattern to the pattern plate. Find the length of the stools *K* which support the plate *I*. The upper surface of plate *I* is as far below the parting line as plate *J*, Fig. 2, was above it, so when stools *K* are cut to the right length, fasten plate *I* to them as plate *J* was fastened to the stools *L*, Fig. 2; also fasten the stools to the stool-supporting plate *H*. Fasten all parts to the machine, putting bushings and pins in the stripping plate.

Now a flask is needed. A flask for a gear should be of iron and of the shape shown in section in Fig. 2.

In making a mold by the stripping-plate method, referring to Figs. 2 and 3, the patterns *A* and *B* are raised up thru the stripping plates *C* and *D* to their uppermost position, and the flasks *O* and *N* are set in place. Put in the necessary facing, set the sprue in the cope flask, in a hole made for it in the face of the cope stripping plate, then fill up with heap sand and ram in the usual way. The taper on sides of flask will cause the sand to pack nicely in the teeth of the gear pat-

tern. When rammed and struck off, remove the sprue, vent the mold and then draw the patterns out of the sand down thru the plates *C* and *P* by means of the handle on the side of the machine. Lift the drag half of the mold off the drag machine and set it on the floor and then lift the cope off and set it on the drag, as shown in Fig. 4. Clamp them together or weight them down, and the mold is ready to pour. The greater number of castings that can be made by the machine over hand work, and all uniform, will soon pay for the cost involved. It is customary for large foundries to pick out several jobs, all about the same size, and make one size of flask do for all of them. In this way the cost of flasks is kept down, and if an extra deep flask is needed, two or more may be clamped or bolted together. A great deal of attention should be given to the flasks, as poor flasks spoil much work.

Incessant Supersession in Engineering.

The following from the address of John R. Freeman before the Case School of Applied Science, at the inauguration of President Chas. S. Howe, rehearses matters not unfamiliar but which are a constant wonder in connection with the progress of the world's engineering.

"This is a transition period, and never was there such opportunity for the trained engineer. Mechanical production must supply the natural increase due to the growth in population, and replace machines worn out by service, and even new machines by something newer. Here in Cleveland your horse cars were not worn out when the cable car replaced them, your cable railways were not worn out when the electric car came in. Not only the equipment, but the shop that makes it, must largely go into scrap. Two or three years ago one of the leading builders of the world began on new shops in a city on the Great Lakes, the largest of their kind, designed for building engines of the most massive type. Hundreds of thousands of dollars were expended on these shops and their heavy machine tools, but, before these shops were occupied, customers were inquiring, not for engines but for steam turbines. The leading pump builder of America began two years ago on new shops near New York, these also to be the largest in the world; the plans had been matured by years of study, for building pumping engines of the ordinary reciprocating type. Before these shops are ready for occupancy, the old and simple and inefficient type of centrifugal pump is suddenly so improved as to threaten a revolution which may profoundly change the type of shop equipment demanded. A maker of valves and pipe fittings, a concern which had kept steadily up-to-date for more than a quarter of a century, started, about two years ago, to supply its expanding trade by a factory on the shores of Long Island Sound, designed to employ at first 2,000 and later 4,000 men. The plans were matured with rare care and judgment. First, their man of greatest skill in shop methods plans for his various machines and lays out his floor space. Next, the skilled mill engineer makes plans to house that floor space in. Next, an architect, of national reputation for his inborn sense of beautiful form and graceful line, models the outlines of exterior wall and windows and roof. Machine tools of latest design have been purchased, apparently everything has been provided for, when, just as the roofs are on, the successful demonstration of a new kind of tool steel, which permits of far deeper and more rapid cuts, calls a halt and requires a radical change. All this is recent and the end is not in sight. Seventy-five years ago, when Cleveland was a frontier village, within the memory of a few men now living, the drydock in the Boston Navy Yard was the most monumental piece of engineering construction and the greatest single work of internal improvement yet completed within the United States, and the total of manufactured power in the United States did not equal the output of one of the large power stations of today."

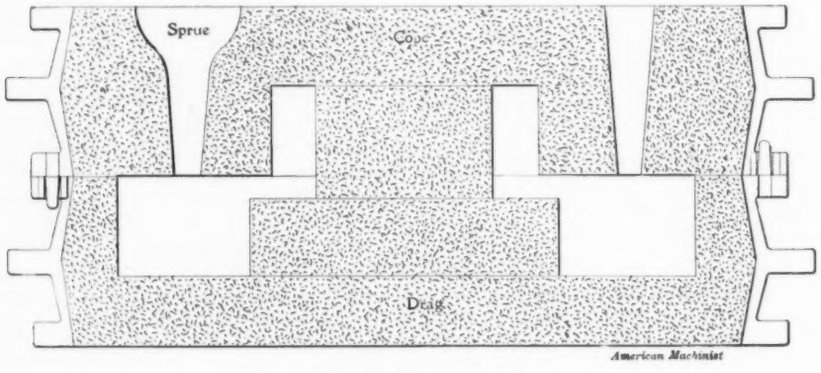
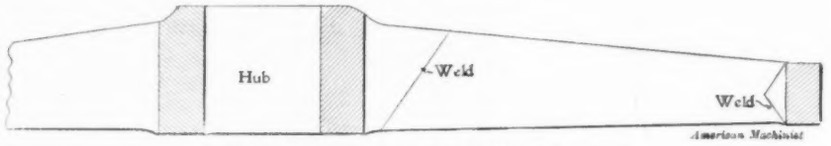


FIG. 4. SECTION OF MOLD COMPLETE.

Welding Spokes Into a Cast-Steel Locomotive Driver.*

I have been persuaded to write of a job rarely done, yet not sensational. Last winter passenger engine No. 1001 came into the Hillyard shops for repairs. It has three pairs of drivers with cast-steel centers 56 inches in diameter. The rear driver on the right-hand side had two spokes broken off between the crank-pin and the counterbalance. About 1¼ inches was left on the hub on one side and 3½ inches on the other side, making an angle of about 60 degrees. On the rim there was about 1 inch left.



WELDING SPOKES INTO A LOCOMOTIVE DRIVER.

Having no centers in stock at the general stores, and as to order from the factory would greatly delay the work on the engine and keep it out of service, our general foreman came to me and told me that he had a driving-wheel center minus two spokes and that he wanted me to weld in two wrought-iron ones in place of them. You may imagine what I thought and how I looked. Anyway, he asked me to go along with him and look at it; so I did, and I looked at it good and long.

Previous to this we had been welding in new centers in cast-steel braces, so I thought that if it was the same metal in the wheel center I would undertake the job, altho I must say it looked dubious just then.

In the first place I got a heavy car axle and flattened it on one end with an offset, so that I could bolt it to the one side of the wheel for a porter bar. Then I got a car wheel on the other end of the axle for a counterbalance, with a man on the tail end to manipulate the wheel in and out of the fire.

I made the spokes of wrought-iron axle and scarfed them like the sketch. The spokes at the hub were broken off almost the way I scarfed them. The rim end of the spoke I made a V weld, as shown. There was hardly stock enough left to form a perfect V, so the scarf came up pretty well on the rim. I took separate heats on the first weld, which was of course on the hub end, and placed the V end in position, allowing stock enough to hammer down with heavy sledges, while the rim prevented it from slipping down, afterward taking a heat on each side.

After the hub and spokes had cooled off, the spokes stood away from the rim half an inch, so I had a liner to fit in between the new spoke and the rim. Before taking a welding heat on this end I heated the wheel each way from the new spokes so

*By W. E. James, master smith G. N. Ry., Hillyard, Wash. Read before the National Railroad Master Blacksmith's Association.

that it would give a little when the expansion took place from welding the small ends of the spokes to the rim. These I welded by taking a heat on each side of the rim. The welds turned out all right, altho I was a little afraid on account of the expansion and strain.

You must remember this wheel center had a solid rim. Sometimes, as you know, there are slits left in the rim in three or four places, which are, I suppose, for contraction after pouring the metal in the mold. Those slits we fit with shims before shrinking the tire on, but there were no slits or openings in this wheel center, so you will understand it was a little more difficult to do a good job. After cooling off it looked O. K. The wheel was then put on the boring mill and skinned off where it was a little lumpy and the tire was shrunk on. The axle fit was not disturbed.

The engine has been running ever since with wrought-iron spokes in a cast-steel center.

"Pneumatic Belting."

In December, 1902, I commenced work in an old mill in central Michigan as head miller. It was in very bad condition. Anything that could be used to transmit power was so utilized, link belting, and rubber being most in evidence. But at some time they had run short on both and had called on the fire department, getting a lot of worn-out fire hose and making use of it. The hose was rubber-lined cotton and answered the purpose quite well, altho it was rather awkward looking.

One day a supply man dropped in on me, and, from the way he looked over the mill, I guess he expected to book quite an order. I was rather busy and knew the management could not afford anything new. The mill had run twenty years without repairs and could run a few more. So when he got me cornered and asked if I did not need a few belts I told him he might book me for some more pneumatic belting.

"Why," said he, "I never heard of pneumatic belts. You must be mistaken."

"No," I replied, "we are using some now," and I took him over to the packer and showed him the old hose.

"That," I said, "is the only kind of belting you can sell me. You see, it never gets loose and one is never troubled by having to take it up. All that is necessary is to pump it up the same as a bicycle tire—and there you are, as tight as a fiddlestring, and no friction on the bearing, as it acts as a cushion. See?"

He saw the argument was all on my side and made the remark that he was afraid he might miss the next car. I guess he caught it all right, for I have never seen him since.—*American Miller.*

A fellow who doesn't know enough to know a thing is impossible sometimes stumbles on to a way to do it.

The Machine Shop and the Home—IV.

BY A MACHINIST'S WIFE.

I do not suppose that any man ever had a job that suited him in every way, any more than any woman ever had a house that suited her in every way. While some things more or less disagreeable are to be expected, and should be endured with the best grace possible, there are other things which make work in some shops much more undesirable than work in some other shops.

Besides the matter of pay for overtime which was not very satisfactory in a certain shop where my husband worked, there was a state of unrest caused, so far as I could judge, by a lack of confidence between the men and the firm. The only argument ever used with the men seemed to be, "You do as you are told or go," without any chance for a man to suggest any modifying conditions. In the matter of wages much the same policy seemed to rule; it seemed to be useless for a man to try to make himself worth more money and then have them pay him more.

We had heard as much many a time, but as there are always some men around most places who think they are worth much more than anyone else ever had any idea that they were worth, my husband used to say he thought it was mostly talk. After he had been working for the company for several years at the same rate of pay, he concluded that it would be as well for him to have a talk on the subject of pay. He had reason to know that his work was good, and that the time he took to do it in was good. He also knew that they had paid more money for getting some of it done. He had felt from the first that the wages had been rather small, but he was not naturally of a dissatisfied turn of mind, and it is altogether likely that if everything else had been pleasant he would never have mentioned wages to them.

One of the results of the conditions in the shop was that we never felt it to be advisable for us to buy a home. We both wanted one, and often talked the matter over, but always came to the same conclusion. It was practically a one-shop town. "If a man gets out there, he is out of the town, and they seem to hold that over a man's head like a club." Will would say: "I have worked for them quite a while, but I have always had the feeling that the firm did not have the least bit of friendship for me, and would displace me to-morrow if they thought it would be in the least to their advantage to do so, and never give the effect on us the least consideration."

It was this feeling that he was looked on as a sort of slave which led up to his going to have a talk on the subject of wages. I will try to show how the interview went. He first approached the superintendent, who said that such matters were in charge of the managing partner of the company. This partner was at the head of the office force, and all the data as to work, etc., were in his hands.

"Mr. Blank, I have been with you for quite a time now, and I hope that my work has given satisfaction in every way."

"We don't keep a man if he can't do his work right."

"I was in hopes that mine was good enough to warrant you in paying me a little more money, as I have tried to make it worth as n ch as I could."

"You are getting full machinist's wages at the present time."

"I am getting the flat rate for all sorts of men, altho I do not think that I am getting the highest rate you are paying. I think I am as well worth it as any man you have."

"We may have a few men that we are paying more than we should, but we have a number that are not getting as much as you are."

"I don't want to talk against any other man's job, for I don't think there is a man in the shop that is getting any more than he ought to have to make both ends meet, but I think that I am not getting as much money for what I am doing as I should get. I have improved the methods on the job I am now at, I am doing more and better work than you ever got before, and I only think it a matter of business that I get a fair return for it. The work must certainly be worth something to the company."

"I have not been finding any fault with your work, but if you are dissatisfied and have made up your mind to quit, of course you are at liberty to do so. Of course if you were worth more to someone else you would not be with us now."

This last thrust hurt. Several offers had been turned down because it meant leaving the town, and I had not wanted to do that. There are numerous strings to a man's life.

"I am sorry to see that you do not look at the matter as I do. I have not been looking for a job anywhere else, for I thought that I was worth as much to you as to anyone else."

This is not all the talk, but in it all there was nothing to show that a man was anything to them but a machine for doing work.

"Some day there will come another chance to work for someone else, and when it does come I will take it and I will never mention wages again to them," was the way my husband closed his account of his efforts, and I knew that some other town would be our home sooner or later.

For one reason or another we had moved several times, and I had become quite expert at it, and so it did not trouble me much when my husband said, "I guess I have that job I have been wanting."

When he notified the company that he would leave in a week they did not act at all pleased and wanted to know what the trouble was.

"No trouble at all. The other people pay more money."

"I don't see why we can't pay as much as they can," said Mr. Blank.

"All that I can say about that is that you don't," was the reply.

"If we were to pay you the same as they offer to, would you not as soon work for us as for them?"

"No, sir. They offer to pay this price for the work they want done, and I thought it over, and from the talk I had with you I did not think it would be of any use to talk with you. You had the first chance and did not want to talk on what the work I have been doing is worth. I told the other people that I would take the job. It is too late to talk anything different now."

The new job did prove different. A man was valued for what he did for them, and it even seemed that they noticed what he was trying to do, even if it was only an effort and did not accomplish much.

Perhaps mechanics are catching, just like diseases are.

Will used to say that there wasn't any use for him to do anything in a mechanical way about the house, as he thought I could do most things as well as he could. I know that after the mystery was once removed I could connect and disconnect gas pipe as well as need be. We moved to a natural gas country, and that solved the fuel question.

My husband went to his new job and left me to move the "household *gods*," as he expressed it, and I did not mind doing it, altho I knew it really meant moving the household *goods*. Inside of a week we were moving into a new home and I was learning the beauties of using natural gas as a fuel, with my husband as chief instructor. Perhaps it may interest some to know something about this very convenient and cheap fuel, and the way in which it is used, or rather was at that time.

"You just mind a few things and you are all right, and if you don't mind them you are apt to blow yourself up and burn the house down, and scare the whole neighborhood"; and here followed an account of some of the awful things that had happened to people who had not minded.

"When you want to light a fire, light the match or the paper first and then turn on the gas. Oh, yes; I know you don't light the gas light that way, and I know that it doesn't have a chance to fill in the stove, and mix with the air, and go off and throw parts of the stove all over the room, and bring out the fire department, and make you go around with your head done up in rags; but that is because there isn't any stove for it to fill in, and there isn't much of it anyway." This was rather alarming, and I suggested that it might be better if we used coal for fuel, as I had heard that many people did even in this land of ideal fuel.

"When gas is used there isn't any question as to who has to build the fire in the morning, and if there is a time that I like to sleep it is in the morning. Gas is just as safe as coal if you use it right; but mind one thing more—never hunt for a leak with a light. If you smell gas, and it is strong enough to cause you any worry, hunt the leak by smell. That is the only safe way."

I found that these directions were good ones, and I never quite blew the stove up, altho I did make the lids jump once or twice, and Will used to say that I used up more soap trying to stop imaginary leaks at the pipe joints than would do a small family. He had told me that soap would stop a very small leak at a joint.

This fuel used to cost $1.50 a month in the summer, and $2.50 a month in the winter for a cook stove, and $3.50 a month for a heating stove in the winter. No one ever had a heating stove if one stove would keep the house warm. There was no restriction as to the number of hours the fire could be used, and no limit as to quantity up to the amount of gas that would come through the air mixer which the gas company furnished. The hole in this was ⅛ inch in diameter. The pressure was given as 5 ounces. The results of this unrestricted use of gas at a fixed price per month were that many people would rather open a window or door if the house got too warm than turn down the gas; they believed in getting all they could for their money, and at the same time people used to complain of the way natural gas warped the furniture. Now gas is sold for 25 cents a thousand feet, and the furniture does not warp nearly as much as it used to.

There is another trouble. Many people complain of the dampness of their houses. The reason is not far away. About 90 per cent. of this gas is CH_4, and when that is burned, the result is carbon dioxide and water vapor. When water vapor condenses it is wet. Neither of these things are obnoxious, and it was the common practice to use stoves without pipes, letting the products of combustion discharge into the rooms. With very thorough ventilation they did not seem to do much harm, but when it was attempted to practise economy, and not heat the house a bit more than it had to be to live in it, the vapor had plenty of condensing surface and the walls would get very wet; often wet enough to cause the wall paper to drop off. With the very best of stoves and of piping there is still some vapor in the rooms, and in very cold weather the windows frost over very heavily.

Manufacturers got their gas at a special price—in some cases as low as 6 cents a thousand, I have understood.

During the year ending June 30, 1904, $880,549 was paid by the Canadian Government in bounties on pig iron and steel ingots. Bounties to the amount of $1,401,804 were so paid the year before.

The Influence of Specifications on Commercial Products—Soap as an Illustration.

The following we take from the presidential address before the American Society for Testing Materials by Dr. C. B. Dudley, chemist for the Pennsylvania Railroad:

It is now perhaps twenty-five years ago that a certain special car happened to fall under the eye of one of the officers responsible for the maintenance of equipment who observed that the varnish on the outside seemed to have perished almost completely, and that the integrity of the painting underneath was in consequence seriously threatened. The car was sent to the paint shop for special examination. The shop reported that the car had been varnished at so recent a date that ordinary wear would not warrant its present condition, and that the loss of varnish was probably due to excess of zeal on the part of the car cleaners. The matter was referred to the foreman of the car cleaners, who reported that they had given the car a pretty good treatment, but that really they could not be held responsible for any better results with the soap that was furnished to them. In order not to be set aside and diverted from his efforts to secure efficiency, by the customary attempt on the part of subordinates who are called to account to transfer the blame to someone else, the officer above referred to asked for a sample of the very soap used, and a partly used cake was furnished and sent to the laboratory.

Now, ordinary cleaning soap, as is well known, is a chemical compound of the various acids characteristic of vegetable or animal fats, with either soda or potash or both. The combination is brought about by the aid of heat, the fats being mixed with the soda or potash in water solution, and the resulting product always containing more or less water as a necessary concomitant of the manufacture. Potash, being more expensive than soda, is less often used. But soda soaps are softer than potash soaps, and, as is well known, the physical condition of a soap as to hardness is an important element in its successful use. Moreover, the nature of the fats used has a most important influence on the hardness of the soap. The soft animal fats whose characteristic fat-acid is undoubtedly largely oleic, when saponified with soda, give a soft mushy soap which is uneconomical to use, is less easy to handle both in manufacture and transportation, and is often unsalable in appearance. These objectionable characteristics are largely increased by the practise, so common among soap makers, of adding a percentage of rosin to the fat. Tallow, which contains a considerable percentage of stearic acid, makes a much better soap. But tallow is more expensive than the soft fats and rosin. Accordingly, soap makers have sought for devices that would harden soaps made from the soft fats and rosin, and it has been found that an excess

of alkali, and especially a percentage of carbonate of soda added toward the last and thoroughly mixed with the soap before it cools and hardens produces the result desired.

Returning now to the partly used cake of soap. A careful analysis of this sample showed that it contained, in addition to the alkali necessary to combine with the fat, about 3½ per cent. of free caustic soda, and over 7 per cent. of carbonate of soda. It will thus be seen that the water solution of this soap which the men were using to clean the cars with was in reality a weak lye, containing quite an amount of sodium carbonate. But both lye and carbonate of soda in solution readily dissolve varnish; even the combined alkali of a normal soap dissolves varnish to a certain extent, but very much more slowly than the free caustic or carbonated alkali, even tho the latter may be in very dilute solution. It is evident that the contention of the men in this case had a foundation of fact, and while it is recognized that the manipulation—that is, the method of using the soap solution—is a most important element in the problem, it is unquestioned that in the hands of the ordinary car cleaner, such a soap as has been described will result in a much more rapid destruction of the varnish than if a normal soap were used. This incident led to the formation of specifications for soap in which the amounts of free caustic and carbonated alkali were limited, and no similar case of very rapid varnish deterioration has since been noticed.

Now this case has not been cited to show that the producer had any desire to ignore or set aside any of the rights or even desires of the consumer, or to obtain for himself any undue, ulterior advantage at the expense of the consumer. In reality, the producer was furnishing more detergent power per pound of soap than is characteristic of the normal article, since both free caustic and carbonated alkali are much stronger in detergent power per pound than the combined alkali of soaps. There is apparently no reasonable ground for an attempt to hold the soap maker responsible for the injury to the varnish, and we cannot help regarding this episode as illustrating "The Influence of Specifications on Commercial Products," in this: that they tell the producer what the consumer wants. It is not to be supposed that the producer will know all the uses to which the consumer will apply his product, and without co-operation on the part of the latter, or, as we have so many times urged, without the two working together, the producer may with perfect honesty make and furnish the wrong product.

In coppering a surface of steel or iron to take scratch marks, a few drops of muriatic acid will make the copperas take hold of the metal even if it happens to be oily, and it is not necessary even to wait for it to dry; just wipe off any surplus of acid with a rag.

Letters From Practical Men.

A Screw Machine Fixture.

Editor American Machinist:

The sketches show a screw-machine fixture and a counterbore for machining the hole in the gray-iron gib shown in Fig. 1. The gib is machined on surfaces *A* and the hole is ½ inch from the edge, as shown, and therefore breaks out ¼ inch at the si'e.

The fixture, Fig. 2, consists of a casting having two projections finished on the under side. There are two steel clamps *B* and *C*; the latter is secured with screws and dowels, but *B* swings out to allow the work to be placed in position. The length of the work is the same as the diameter of the fixture, so it is placed central by bringing the ends flush with the fixture perifery and is secured by means of the elevating screw and the two clamp screws. The slot in the clamp *B* should be a close fit to avoid the liability of springing the fixture when the elevating screw is raised. The fixture is doweled to a face-plate and held by screws.

The first tool used is a starting drill, a 13-16 inch drill follows, and the counterbore, Fig. 3, with the "disappearing" pilot removes most of the remaining stock. The last tool is a bottoming reamer having teeth milled on a left-hand spiral at a 15-degree angle.

The counterbore may have the flutes milled within about ⅛ inch of the pilot and then have teeth on the end. The pilot should be very hard, a close fit and backed by a good, stiff spring.

W. E. WILBER.

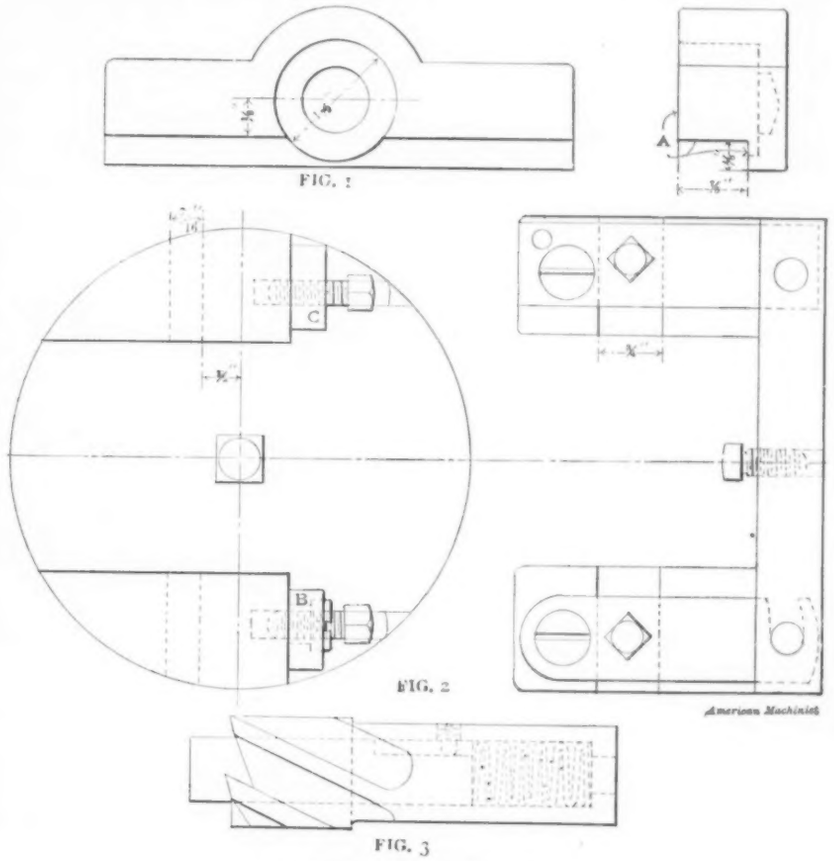


FIG. 1

FIG. 2

FIG. 3

A SCREW MACHINE FIXTURE.

Three Time Killers and One Killed.

Editor American Machinist:

Three things in the shop trouble me and have troubled others. First, where are all the drill-press collets and chucks? Many a man has had to look for them, even in the well-appointed shops. And some have tried to remedy the evil by keeping them all in the toolroom; but for goodness' sake don't do that. I have spent more time in the last week going to the toolroom for chucks and collets than a chuck is worth; so, until some bright mind finds a good way to keep them where they will be handy without the probability of their getting lost, please leave them on the rack beside the drill press.

Second, where are all the milling machine wrenches? What a handy thing they are, and how inconvenient not to be able to find the size you want. I don't know any better way to overcome this difficulty than for someone to invent a monkey-wrench that can be quickly adjusted and that can be carried in the pocket, and then if you don't lend it you will always have a wrench.

Third, who has the center key? How many times have you knocked the handle off the file so that you could use the file to take the end mill out of the collet?

Some time ago, after getting thoroughly disgusted with seeing so much time wasted on the absence of this small article, I wound up about 25 feet of coil spring (close wound) and fastened about one foot of it to each key and secured the other end to a convenient place on each machine. When the key was wanted it was always found hanging at the end of the spring, which would stretch quite a distance while the key was in use. It just suited a careless man, for he never had to look where he laid it and it never got mislaid. All he had to do was to let go and it could not help going back where it belonged.

C. M. C.

Set of Tools for Forging a Fulcrum Bracket.

Editor American Machinist:

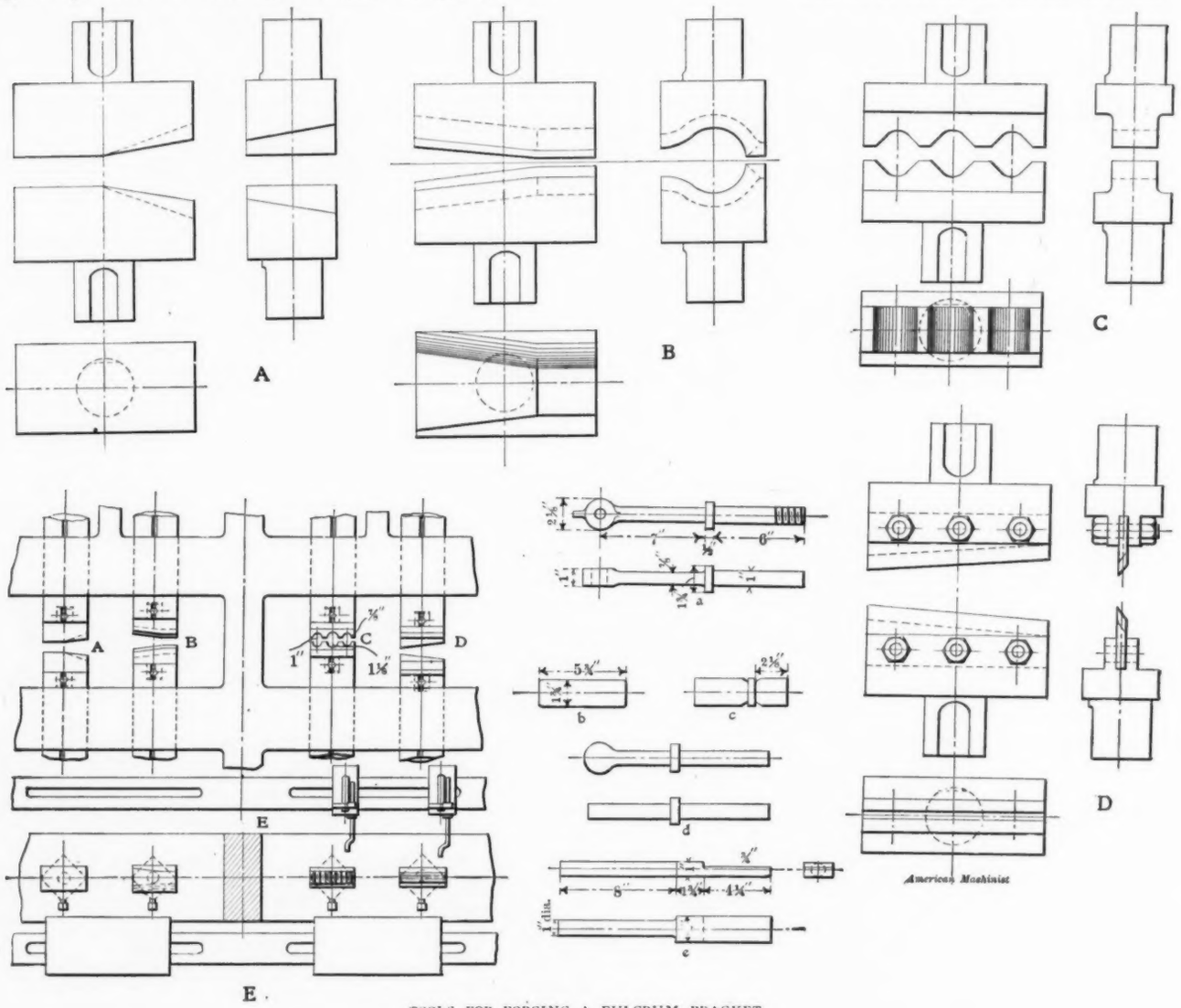
During recent years much progress has been made in forging and in smith work generally. The old and more tedious methods are dying out, as forging machines and appliances are adapted to the work. Among these the swaging machine deserves particular attention and on straight work it is really a labor-saving device in every sense of the word.

I wish to illustrate a set of tools used in this machine for making a fulcrum bracket in connection with railway brake gear. These tools, however, are not confined to this particular job. As will be seen, the job is admirably suited for the swaging machine; to drop forge it would be a waste of time and material. *A* shows a set of breaking-down dies, *B* a set of formers for shaping the eye, *C* an ordinary set of ⅞-, 1- and 1⅛-inch swaging dies, *D* a set of cutters the construction of which will be readily understood from the sketches. *E* shows the arrangement of these dies in the machine and the method of securing in place. The stroke of the upper rams is ¾ inch and they make 600 working strokes per minute. All the lower rams are adjustable and can be instantly raised or lowered at the will of the operator. At the side of the machine is a hot circular saw.

The blank shown at *b* is cut off at the shears to the required length, very little being allowed for scrap. It is then brought to a working heat in a suitable furnace, which should hold at least six pieces and is fed into the cutters *D* where by means of the gage shown first one side of the collar is formed and then the other, as seen at *C;* in the same heat the short end is rapidly broken down between dies *A* and swaged to the required diameter by first passing it thru the 1⅛-inch swage and then 1-inch at *C*. The operation is finished by trimming the end to length in the hot saw, and all others are treated in like manner.

For the second operation, the other end is properly heated and rapidly broken down under dies *A*, and appears more or less like *d;* the enlargement for the eye is then formed by passing it thru the dies *B* and the flat of dies *A* several times. The swaging dies *C* are then opened to receive the round part between the eye and collar, and this is neatly finished off there until the eye is the correct distance from the collar, when it is again released and the tit formed on the end sawn off.

It should be understood that these operations must be rapidly performed, two heats being required to finish the piece. It will be noticed that dies *A*, *B* and *D* are so set as to produce the finished size without any adjustment.



TOOLS FOR FORGING A FULCRUM BRACKET.

The piece at *e* is another forging produced on this machine at such a price and with such a finish as to give satisfaction all around. WM. F. HOFFMANN.

Manchester, England.

Drill Jigs.

Editor American Machinist:

The sketches show two pieces of work and jigs for drilling. Fig. 1 is a casting which has eight holes drilled in it, the piece having been previously finished all over from the center hole. In Fig. 2, *A* is a hardened and ground shaft fitted .0005 inch loose in the jig, and *B* is a hardened block which has a projection on the back side fitting a hole in the jig, and is provided with a screw to keep it from turning and to retain it in the jig.

To operate, *A* is removed and with the work inserted in the jig the shaft is put thru both the jig and the work. *B* is then forced against the bottom of the slot in the work by means of the screw in the back of the jig, and serves a triple purpose, locating and clamping the piece and acting as a bush block. The bushings in the top of this jig are made long and one side has to be flatted to clear the work.

Fig. 3 is a gray-iron collar finished all over, and Fig. 4 is the jig for drilling the two holes for the screws by which the collar is fastened to the end of the casting, Fig. 1. This jig is all steel, and the plate *C*, which clamps the work and carries the bushing, is quickly removed by loosening the upper nut and slipping off the slotted washer. W. E. WILBER.

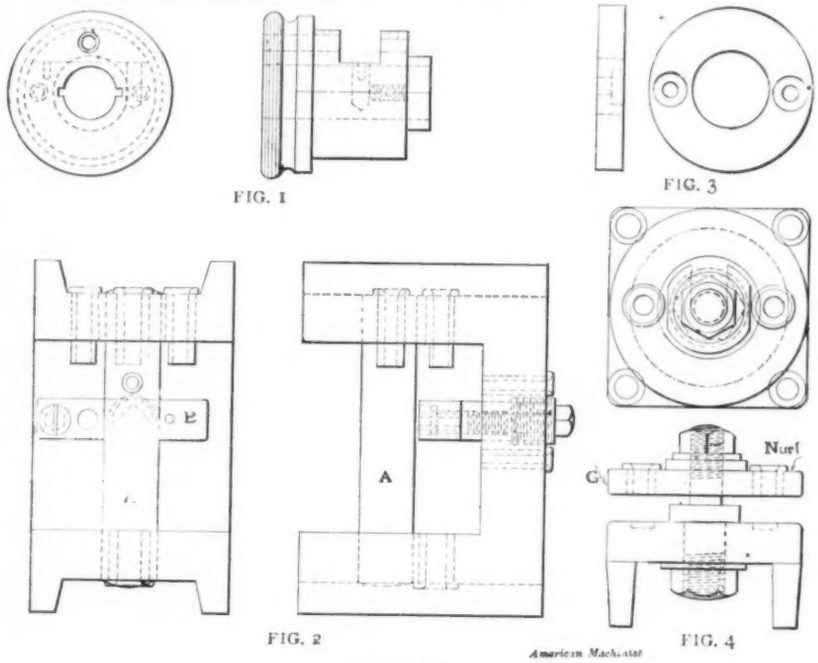


FIG. 1 FIG. 3 FIG. 2 FIG. 4

American Machinist

DRILL JIGS.

Making Cheap Wood Pulleys.

Editor American Machinist:

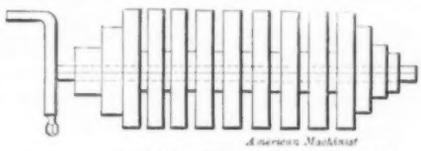
I have read with interest the letter by Cameron, at page 1173, about "Writing for the AMERICAN MACHINIST." Both as a journeyman and a former employer, I have had many an odd job that would have puzzled many a good mechanic, so I think I am somewhat qualified to become a member of your "writing force."

I had an order some time ago to make 500 wood pulleys like Fig. 1. They were to be 6 inches diameter, 1-inch face and grooved for ¼-inch round belt. The pulleys were to be fastened on shafts, so they had to be bushed. The price I was to receive for them was not consistent with strictly high-grade work, and in fact they did not require to be over nice, so I made them as I will tell, which I think was the quickest way, considering the tools available.

I had the lumber, which was birch, sawed and planed smooth to exactly 1 inch thick and in 12-foot lengths. The pieces were cut about 6¼ inches square. The corners were then sawed off and they were ready for drilling. The holes were drilled on a 12-inch swing screw cutting lathe, which, by the way, was the only lathe in the shop, and we used a Morse machine bit for wood.

The next thing to do was to make the bushings, and I confess that I thought I would be a loser when it came to that part of the job, but I found a way out. I took brass tubing approximately ¾ inch outside diameter and about 31-64 inch inside diameter, to allow for finishing to the ½-inch bore. They were then sawn to 1 11-32 inches long.

I then took round bar brass 1 9-16 inches diameter, cut in 12-inch lengths, chucked each piece, supported the end on a steady-rest and bored thru its entire length with a flat drill, starting with a small drill and finishing the hole with a larger drill. The drill was about the thickness of tissue paper less than the outside diameter of the brass cylinders. After the drilling the collars were cut off 11-32 inch wide. The next step was to take a piece of gray iron and bore it a running fit for the cylinders, afterward facing it true on a mandrel. The cylinders or bushes were then filed to fit the brass collars properly, so that solder could run into the joint. The cylinders were then each stood in the gray-iron collar, a brass collar was slipped on and the two were hard soldered together. This done properly makes



American Machinist

FIG. 3. PULLEYS ON A MANDREL FOR TURNING.

as neat a job as anyone can want. The completed hubs were faced to size by a 'prentice boy, and four holes were drilled parallel with the bore for 10-32 flat-head screws, and a tap hole was drilled at right angles to the hole for a 10-32 screw. The bushings were fastened on the wood and the pulleys were ready for turning.

For a turning tool I took a ¾-inch wood turner's gouge and forged the end to fit properly in the tool-post. The pulleys were turned eight at a time with a coarse belt feed, two cuts being sufficient.

After the pulleys were turned to size I reversed the lathe to groove the pulleys. I could not afford to change the turning tool, so I made a rest out of bar iron,

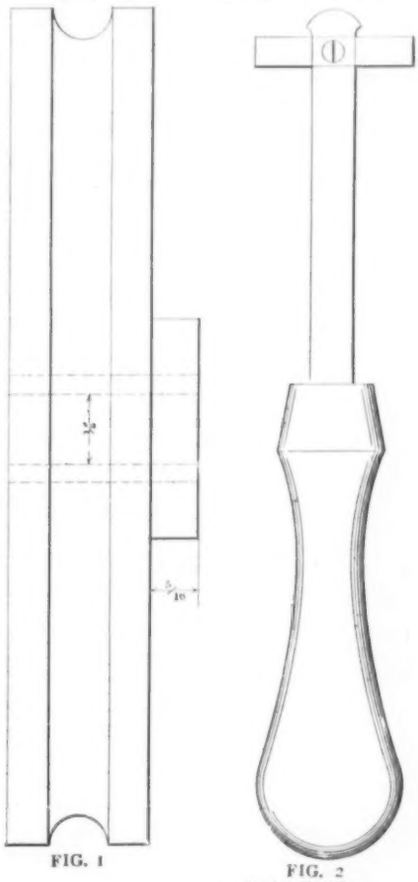


FIG. 1 FIG. 2

American Machinist

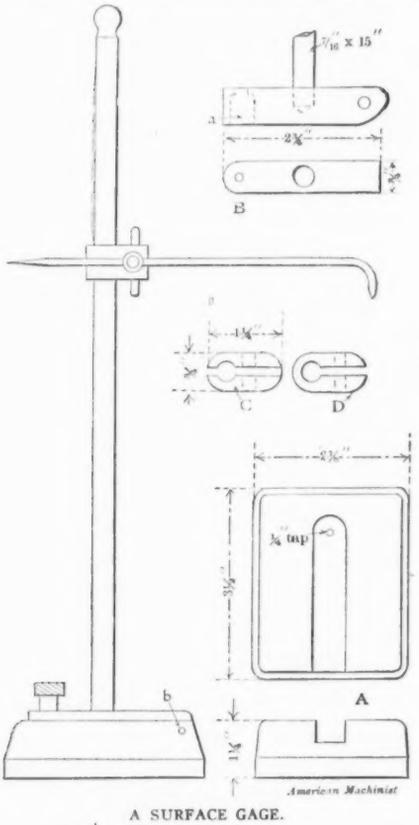
MAKING CHEAP WOOD PULLEYS.

¼x1 inch, which required only the drilling of two ½-inch clearance holes and a little bending to fit it. A hand-tool supported on this rest with the proper curve grooved the pulleys, and to get them all to the same depth I screwed a cross-piece of steel at the proper distance from the end of the tool, removed all its sharp corners and hardened and polished it, that it should not scratch the work. I made 500 pulleys in this manner, and if I were today to make 5,000, I know of no better way. L. I. ROSENTHAL.

A Surface Gage.

Editor American Machinist:

The surface gage shown is a good, stiff and simple tool easily made. The base *A* is made in two pieces, the casting being



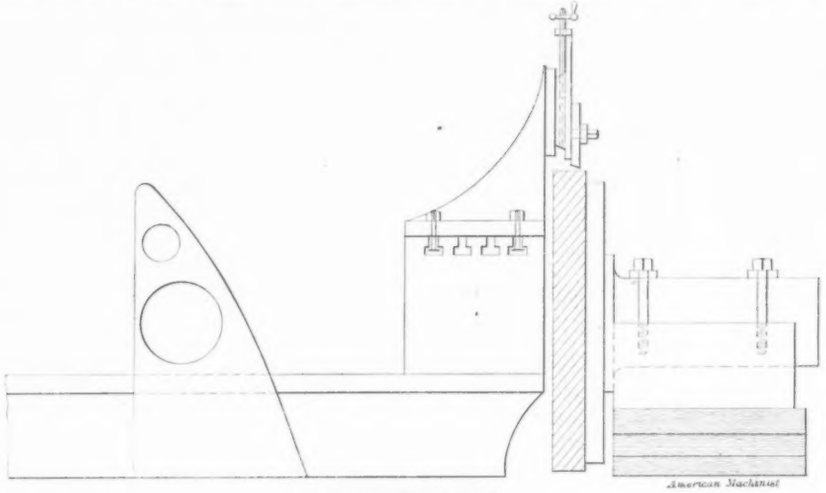
A SURFACE GAGE.

planed out to a drilled hole and fitted with a piece of ¾-inch cold-rolled stock *B*. The fit must be a nice one to prevent any wabble in the rod. The piece *B* is drilled out at *a* to admit a coil spring which must be stiff enough to hold the rod firm; the rod is to be a snug fit in its hole, and may be made removable so as to be replaced by a longer rod when desired. The base is tapped for a nurled head screw, which compresses the spring and gives adjustment to the needle, and is drilled thru for a pin at *b*. In making the head or slide it is best to split it as at *C*, for if split like *D* the nut will not have as true a seat and will not clamp so tight. The sizes given make a very neat proportion for an 18-inch gage. As there is no patent on this tool, any machinist with the stock can make one in a short time. CAMERON.

A Slotting Job on the Planer.

Editor American Machinist:

The sketch shows how we used our planer to machine the tool slots in the cutter heads of two 64-inch rotary planers that we built. The men were all guessing how it was going to be done, as we had no planer large enough to allow us to set the cutter heads on the platen, and to do the work on the slotter would have been inconvenient on account of the tool slots being on an angle of 63 degrees with the face. We fastened the cutter head to the spindle and placed the spindle in the lower half of its bearing, which we placed on heavy timbers built at a hight that would allow the cutter head to clear the floor, so that we could turn the head as required for the different slots. On the planer we placed the square table of a radial drill and on that bolted the largest angle-plate we had, with a pair of 3-inch parallels underneath to bring it to the proper hight. On the angle-plate we bolted the cross-rail of the planer. That giving us a cross-feed and down feed, we could machine the slots without any trouble; with a heavy cut there was hardly any spring in the work or tool. WILLIAM SWARTZ.

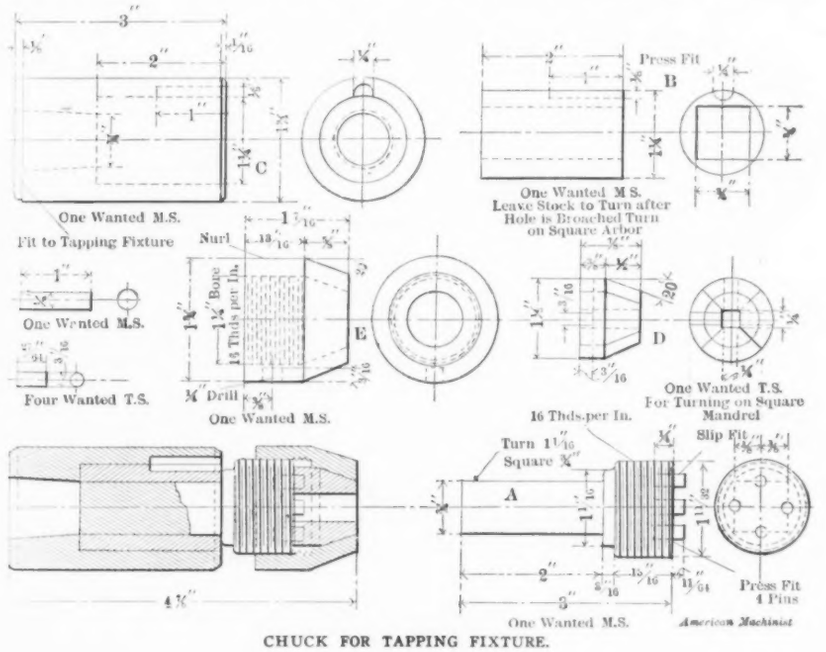


PLANER AND WORK.

Chuck for Tapping Fixture.

Editor American Machinist:

The blueprint shows a very handy tap chuck which, while not new, may be of interest and useful to some of your readers. The body *A* is of machine steel, with a square shank to fit the broached hole in sleeve *B*, which is turned to fit sleeve *C* and held by a dutchman, as shown. The four pins in the face of *A* are a loose fit in the slots in the back of jaws *D* and



CHUCK FOR TAPPING FIXTURE.

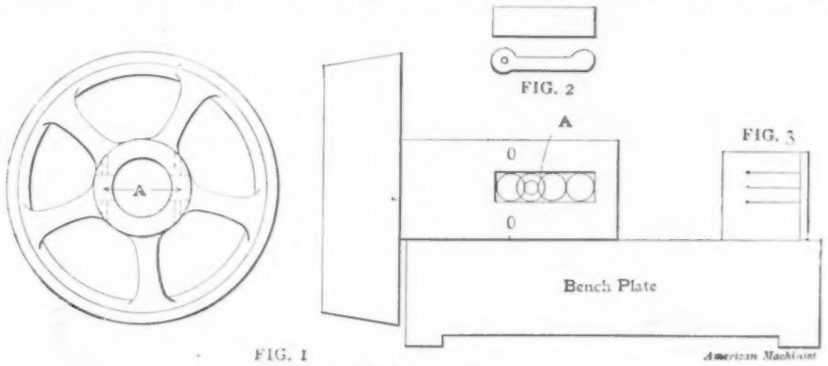
act as drivers. The jaws were first drilled and broached ¼ inch square, and after turning, and milling the slots in the back, were sawed quartering, making four jaws; the metal removed by the saw allows the jaws to grip ¼ inch square and they can be opened to take ⅝ inch. The jaws are

held in place and adjusted by the nurled cap *E*. Sleeve *C* can be made to suit the tapping fixture. F. I. X.

Laying Off a Job.

Editor American Machinist:

On a turret lathe we built was used a friction drive, and one piece, as in Fig. 1, had a long hub in each side of which a rectangular opening *A* had to be finished out to fit a finger like Fig. 2. The fingers were finished standard and it was necessary that the holes be just right so that both fingers should come in contact at the same time.

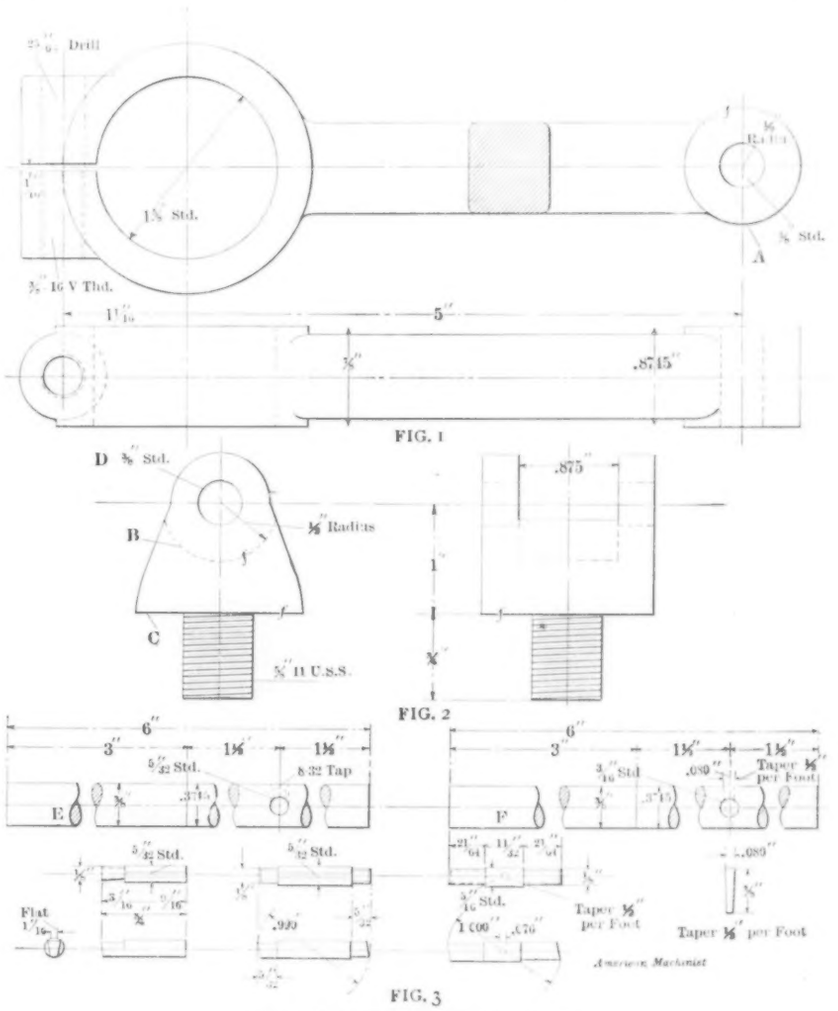


LAYING OFF A SLOT.

The custom had been to lay the job off as in Fig. 1 with a surface gage and dividers, then drill the holes out as shown, using a smaller drill on the narrow web left, for fear the other drill might catch.

In using the surface gage the man would set it each time to a scale, or three times to each piece. It's a little hard on the eyes and nerves to figure and set a surface gage a number of times to a fine scale.

There had been some trouble in getting a good job when using a drill just the right size, as the surface being round, the drill was hard to keep within the circles. The job fell to me one day to drill and fit a lot of these pieces. First I secured a nice, finished cast-iron block, Fig. 3, and laid off the three lines on it, making three little punch marks in order that I might locate the fine line more quickly. The block saved any further figuring, and as I didn't have to hold a scale I could set the surface gage much quicker with my two hands. In punching the marks for the drill I was careful to get a nice, clean mark and then run a 1-16 inch drill thru first, and the larger drill followed the small drill and made a good job. It was also easy to drill out the narrow web when the small drill was first used. The holes for the pins the fingers swung on were drilled with a jig. CAMERON.



THE WORK AND THE BORING TOOLS.

Boring a Knuckle Joint.

Editor American Machinist:

I had to get out the joints, represented in the accompanying sketches, for an experimental lot of small power presses. The end *A* of the connecting rod, Fig. 1 (of gray iron) was to bear on the surface *B*, Fig. 2, of the plunger connection (of comface-plate being used to insure squareness. The angle iron was then split and a binding screw put in.

When the connections had been turned and threaded, they were squared off on the face *C* until the sides came approximately parallel with the edges of the angle iron (square with the face-plate) when screwed in hard. Then the angle iron was placed on the face-plate, well secured by straps, and set the required distance (one inch) from the center.

One of the connections was then screwed into place and firmly bound, and hole *D* was drilled, bored and reamed to ⅜ inch standard. Then the bar *E* was put in, the outer end being gripped in a tool-holder, and the cross-slide was adjusted so that the bar ran free in the hole, and was then gibbed tightly in place. The cutting-down tool was inserted, set so that it just cleared the bottom of the recess, and the screw lightly tightened on it. Then a slight tap on the tool with a small hammer and a turn of the lathe by hand took out a small chip. By repeating, a tap and a turn, a tap and a turn, the cut was soon carried down to the proper depth, gaged from the bar by an inside caliper, set to the micrometer. Then the double-ended cutter fitting this bar was placed central in the bar and started in the cut already made. It was fed both ways as far as possible, till the round body struck the ears of the piece; after this it was set out of center just enough, by gage and trial, and was used as a single-end cutter to

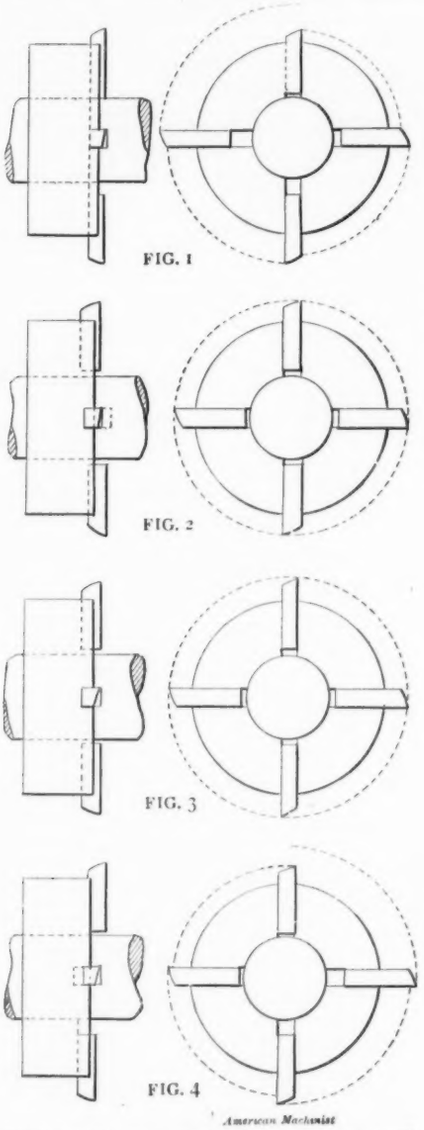
finish the bottom to size. Then, the bars being exchanged and the remaining cutter, which is really a double-end counterbore being inserted, and secured by the taper pin, the sides were nicely cleaned up smooth, square and to gage. The connecting rods were easily fitted, finishing the work.

HERBERT V. PURMAN.

How Should the Boring Tools be Placed?

Editor American Machinist:

I am really not asking for information, for I have my own opinion and, I am afraid, I'll stick to it. But I had to argue the question so many times and with so many people that I thought it a pretty good riddle—good enough to go on the funny page of the AMERICAN MACHINIST.



HOW SHALL THE BORING TOOLS BE PLACED?

A boring head has, say, four tools spaced evenly around the circumference. The toolhead may be rotating and feeding, or the head may be feeding alone while the work is rotating, or else the work may do both. The question is, how should the tools be placed so as to make each of them do an equal share of the work?

Fig. 1 shows all four tools in the same plane, but set to different diameters, the largest diameter being the size of the rough bore (my riddle does not hold for finish boring). The diameters to which the different tools would bore increase by equal amounts.

Fig. 2 shows all tools set to equal diameters, but not in the same plane, the distance between the different planes being equal to one-fourth of the feed desired.

Fig. 3 shows all tools in the same plane and set to the same diameter.

Fig. 4 shows the tools in the same planes as in Fig. 2 and set to different diameters as in Fig. 1.

Which is right? I hope to have the pleasure of reading the opinions of a great many men, and I promise to give mine when the returns are in so I can go with the majority.

A. L. DE LEEUW.

Hamilton, Ohio.

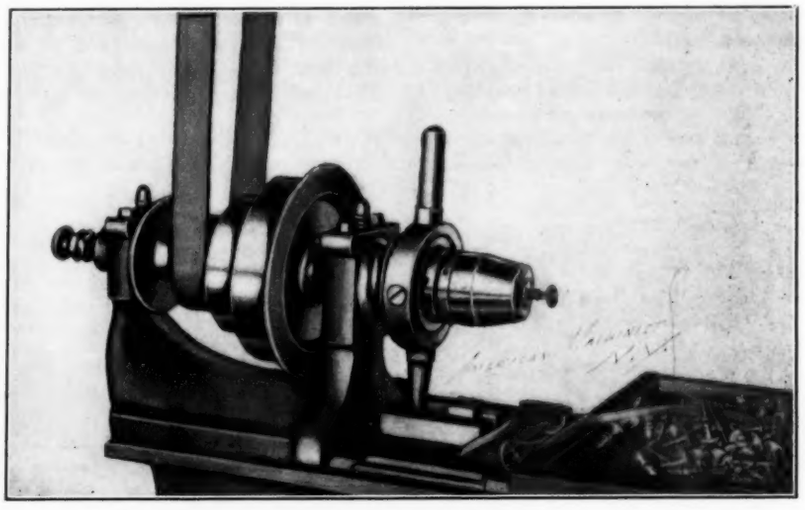


FIG. 1. THE CHUCK IN OPERATION.

Quick Operating Chuck.

Editor American Machinist:

The photograph and drawing show a quick-operating chuck which has been in use since 1902, has proved to be practical and has the advantage of cheap maintenance. It can be made to fit any of the standard spring collets (this one is fitted to the Pratt & Whitney). It also retains

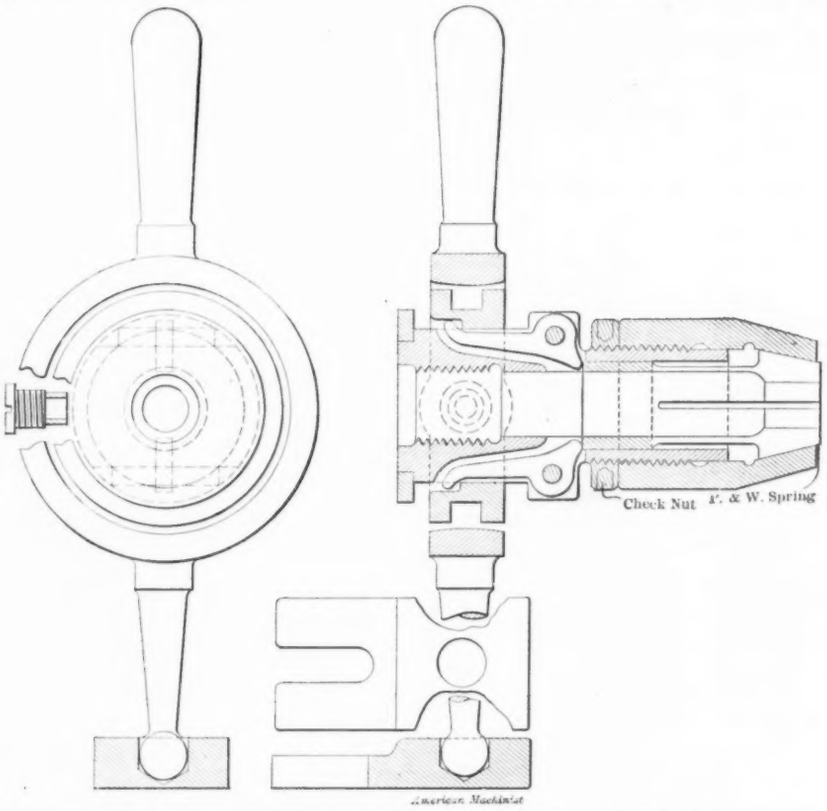


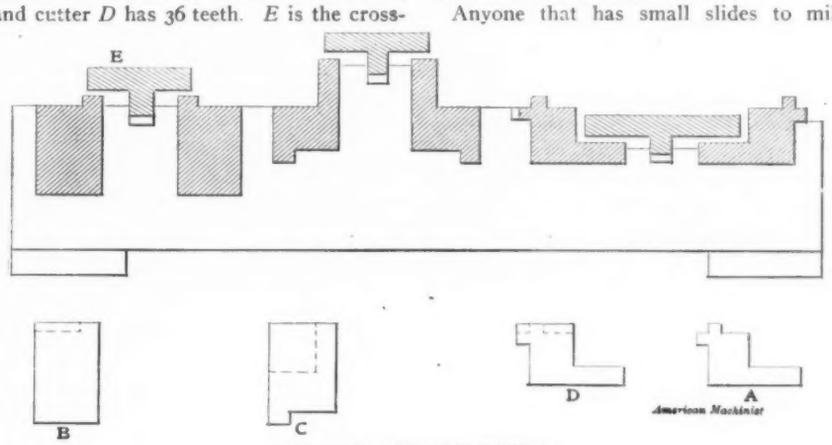
FIG. 2. ARRANGEMENT OF THE CHUCK OPERATING MECHANISM.

its alinement or truth remarkably well; in fact, it will not run out of truth unless the collet is broken or is not properly hardened, allowing it to wear on one side more than on the other. P.

Fixture for Making Worms on the Screw Machine.

Editor American Machinist:

This fixture was made to cut worms of .166 inch lead on a Pratt & Whitney screw machine. Gears *A* and *B*, Fig. 1, have 36 teeth each; worm *C* is .166 inch lead, and cutter *D* has 36 teeth. *E* is the cross-slide on the screw-machine bed; *F*, the tool-holder which supports cutter *D* and worm-wheel *G* on shaft *H*. Cutter and worm-wheel are driven by means of worm *C* on shaft *I*, which is driven by gear *A* when it comes in contact with the gear on the screw-machine chuck cap. Holder *J* has a long sleeve *K* driven into it, to give a long bearing for shaft *I*. It will be noticed that the cutter can be ground on the face when dull, and adjusted to the center line by means of screw *L* and hardened sleeve *M*. Fig. 2 is an enlarged view of the cutter and the worm when cut with this fixture.



THE WORK AND THE FIXTURE.

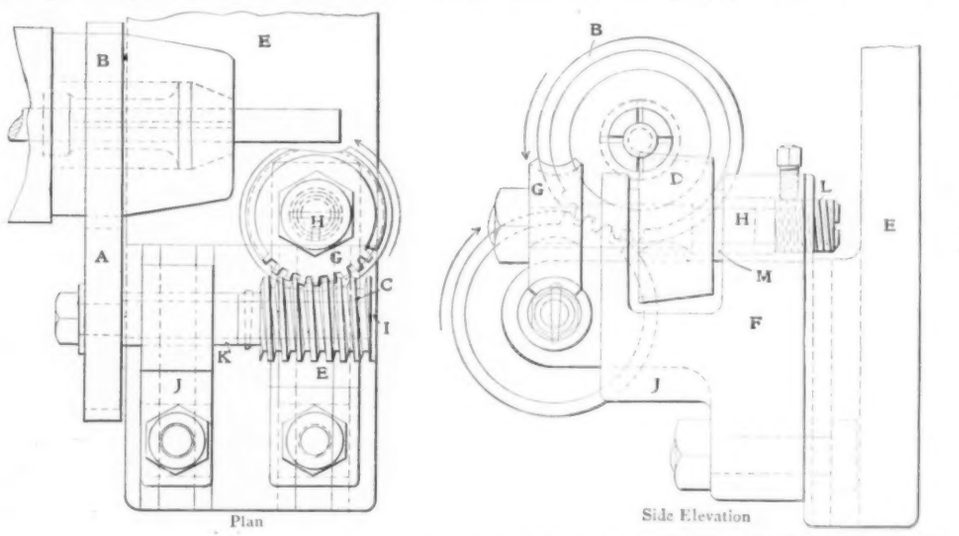


FIG. 1. FIXTURE FOR MAKING WORMS IN THE SCREW MACHINE.

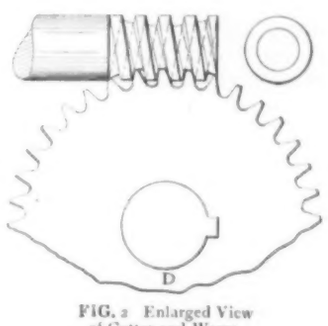


FIG. 2 Enlarged View of Cutter and Worm
American Machinist

It will be noticed that the body of the worm is cut down to the radius of the cutter; and in making the latter the size of the worm-wheel to be used must of course be taken into consideration.

The rapidity with which a worm can be cut with this attachment is surprising. To use the fixture, you grip the bar of stock firmly in the chuck; then, before starting up, interlock gears *A* and *B*, then start the machine and feed the cutter in, with the cross-feed lever, to the necessary depth.

A. B.

Milling Long Steel Strips.

Editor American Machinist:

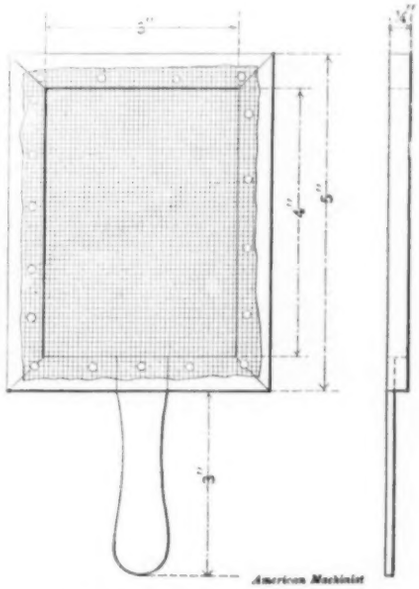
Anyone that has small slides to mill may find this sketch of value. At *A* is an end view of a slide about full size and 24 inches long. The pieces are made from ⅜x9-16 inch tool steel and have to be accurate within 0.001 inch. At *B*, *C* and *D* the progress of the work is shown by dotted line. The small clamps *E* fitting in ⅛ grooves are held down by a small eccentric binder, two springs, which are fitted beneath, raising the clamps when the eccentric is released. The milled portions lying in horizontal lines enables us to use gang cutters of one diameter.

E. W.

For Extensive Spatter Work.

Editor American Machinist:

The article by C. L. Carman at page 1345, about making earth sections on drawings, calls to mind a method I used some years ago to make a spatter work background. The work was not such as comes up very often in the ordinary work of the drawing room, but would be met perhaps in an engraving establishment, tho doubtless they have a still better way of producing the same effect.



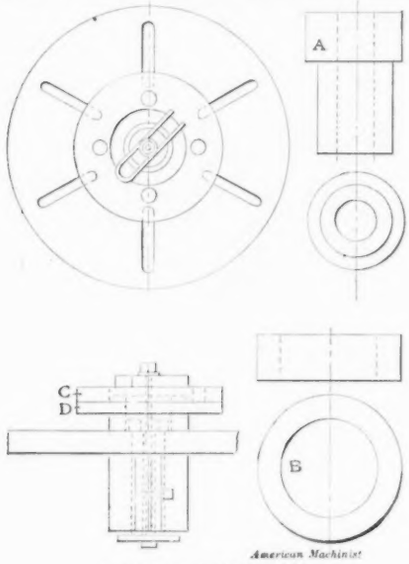
FOR EXTENSIVE SPATTER WORK.

I was mounting a lot of photographs on large cards for making half-tones and I used pressed leaves and spattered ink over them and around them as a background. In order to cover a large amount of surface rapidly, I made a little frame similar to enclosed sketch which I covered with ordinary wire screen or mosquito wire. By holding this in my left hand at a distance from the paper best found by experiment, and rubbing the bristles of a tooth-brush dipped in ink over this wire netting, I was able to cover a large surface in a short time and to shade the spatter work very readily. W. E. Morey.

A Simple Drilling Rig.

Editor American Machinist:

I have found the arrangement shown in the sketch to be a help when getting out duplicate work in an ordinary drill press. A hollow arbor shown at *A* is fitted in the center of the table and rings *B* are provided to fit any needed diameter; the circle



A SIMPLE DRILLING RIG.

of holes in templet *C*, which is clamped to the work *D* by the bolt passing down thru the rig, can be kept in line under the drill by merely rotating the table. R.

How to Charge a Lap — A Proved Surface Lap and Straight-Edge.

Editor American Machinist:

A surface lap, to most mechanics, is a tool to be abused, judging by the way they charge it. A lap to be of good service must be charged in such a way that it will cut fast and finish the work acceptably. Acceptably means a finish proper for shop gages. When you have tried this way of charging, and see a lap roughing and then finishing a surface of hardened steel, until it looks like blue sky, you may be sure the standard of finish is high enough for any shop.

The surface of a lap once charged by force, either rubbing or rolling, has received all it can; you sprinkle more abrasive on and force it where? between the particles that are embedded. True, you displace some of the old abrasive and renew it with fresh, but to do it you must use considerable force, and that is what I mean by abuse.

The use of a roller for charging is not so bad as a rubbing block of gray iron: the block allows the abrasive to roll and rub, get dull, and cut both lap and block. Just look at that charging block and see the condition of its former flat face, then you may acknowledge that what caused that can't be very good for a true flat surface, which a lap must have to do good work and keep the man from guessing whether it is the fault of steel or lap that that work is in such shape—its corners and edges all gone, or its surface convex or concave.

The actual wear on a lap is so small when charged in the way about to be described that in a test we could not decide whether it was wear or natural changes in the iron, the laps being from new castings; so we took one and resurfaced it and I used it every day lapping small work for more than a year, and before leaving for another place trued up my tools on it and it stood the same test as when first made.

The foregoing refers to gray-iron laps. Keep the roller off of lead laps; they roll the edges down and make the lap very crowning.

Just a small squirt of kerosene, a little 15-minute carborundum or flour of emery, enough benzine or gasoline to spread the abrasive and kerosene over the surface, using a block of hardened steel (I use an old press die 3x4x¾ inch) once in a while to gray the glassy surface which does not hold the abrasive properly. For all other charging, just use a piece of cheese cloth rolled up like a shredded biscuit and rub lightly, using the kerosene and gasoline.

The first thing to look for is a surface on the lap that looks as if the work were plowing; you will lose your edges and corners if it does plow, and you will know then that you have used too much kerosene. Just a little more gasoline will cure that. Then you will have a lap that will cut and you will be surprised how little fresh abrasive it takes to keep it cutting. That cheese cloth seems to hold a lot more; but you put a little more on out of pity for the abrasive manufacturers, not that it seems to need it to cut. I have wondered if the steel particles lapped off of the work didn't cut and help out.

That lap will not gather little glazed spots, or "birds' eyes," as they are called, and you will have edges and corners in the surface plane. Just as soon as it gets dry repeat the process without the rubbing block; use that only once in a while, and you will always have a coat of *stationary* abrasive between the work and lap. When the work finishes dull and the lap becomes gummed, take a fresh fold in your cheese cloth.

We use lead laps for lapping gray iron or composition brass, where the parts to be lapped are not used as bearings subject to wear.

Our laps are annealed solid castings 2½x10x12 inches, of fine-grained gray iron, and must be soft and compact. They are planed on top and sides, but without grooves or checks (which are fallacies to me), then scraped to a surface plate, keeping the spots close together. When a good, close-spotted surface is obtained we blend the spots by placing one lap on top of the other—with 120 emery and kerosene between—and grinding them together (this shows up the effect of rolling force). Then they are tested in this way, which originates a practical straight-edge also:

In Fig. 1 piece *A* is a straight-edge 1-16 inch thick at the edge, hardened about ¼ inch back on that edge. Rub it on the lap about to be tested, holding it against a parallel to keep it flat on the 1-16 face, and go all over the lap; now you have the opposite of the face of the lap. Now take a knife-edge straight-edge the same length as at *B*, lap it up (without the parallel) covering the same lap surface, which duplicates the lap surface again. Now place the edges together as shown, and you will have twice the error of the lap if there is any. The light showing in the center of the straight-edges, the laps are crowning; if open at the ends, the laps are hollowing. Take the concave laps, sprinkle the 120 emery evenly on the edges and rotate the top one, when placed together flat, in a complete circle. Look out for emery working into the center where you don't want it to cut. Do likewise with convex laps, using emery in the center and keeping it away from the edges. A block of gray iron 5x5x1 inch makes a good rubber to start the convex laps in the right spot or to correct spots.

Fig. 2 is a rest to hold *B* on the face of *A*. It is made of No. 30 wire bent up and extending above *A* far enough to allow *B* to rest against it when *A* is in the loop at the bottom.

That's the way we made laps in a certain room. There were eight of us and there was a lap for every man, and he finished a glass test bar for straight-edges for himself; knife-edge squares were as common as beam squares; a right angle was as easy to create as a straight-edge on these laps. It must be understood that this way of charging does not apply to the precious stones as abrasives.

A few points to keep in mind: A lap

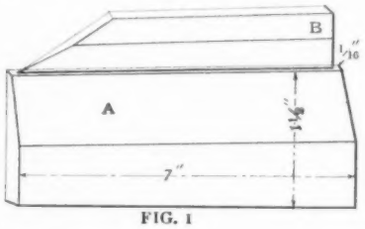


FIG. 1

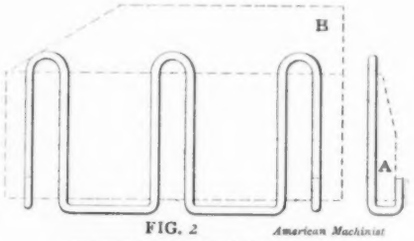


FIG. 2 American Machinist

TESTING THE STRAIGHT-EDGE.

flooded with oil and abrasive will not cut hardened steel as fast as one which is charged with just what abrasive will cling to the surface of the lap. Rolling abrasive crushes the lap surface and fills into low places in the work, which causes more lapping, for it cuts where you don't want it to. A lap flooded with dry abrasive acts

the same, with addition of "birds' eyes" or spots of glazed abrasive.

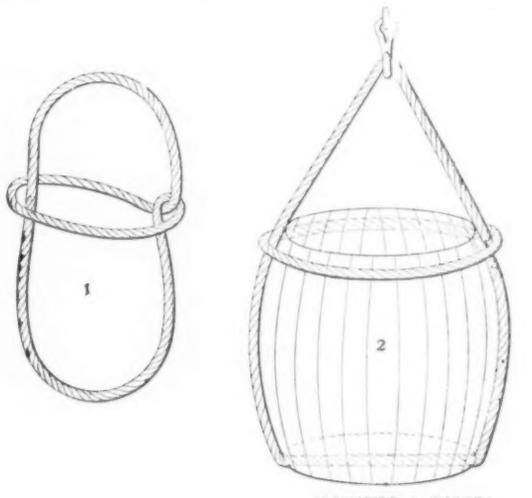
A good sprinkler for fine abrasive consists of a couple of folds of cheese cloth about 4 inches square with the corners gathered up around the abrasive and tied with a string.

I have spoken of grooves and checks as fallacies. Just try this way of charging a lap, give it a careful trial, and see if you want to go back to the old style. Simple as it is, there is no apology going with it. SCOTTY.

Knots and Hitches.

Editor American Machinist:

At page 592 are given a number of useful knots and hitches. It is often, however, necessary to sling a barrel containing small castings or liquids. While with both heads on and the bung in place this is an easy job, but with one of the heads out it is amusing to see the amount of rope the average landsman will take to lash the barrel in such a case. The illustrations 1, 2 and 3 show how this can be done with an ordinary sling. DIXIE.



SLINGING A BARREL.

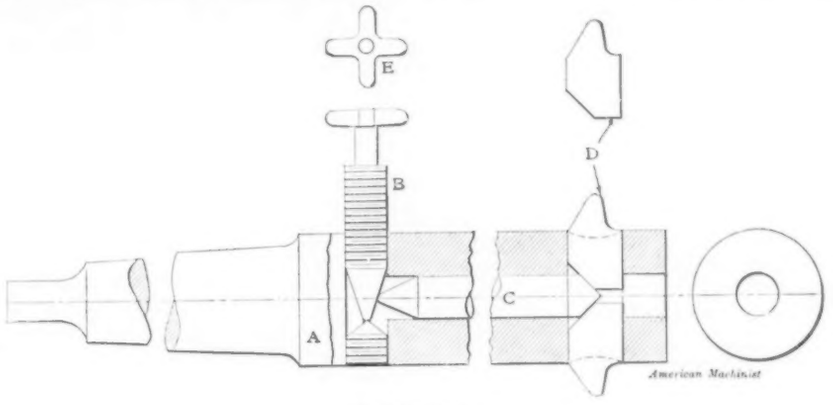
A Recessing Tool.

Editor American Machinist:

I send a sketch of a bar for recessing which can be used in a drill press or a boring mill where the ram cannot be moved out of center.

A is the bar proper, and *B* a screw which is tapered part way to force the pin *C* down the hole in the center of the bar to expand the cutters *D*. *E* is a knob on the end of the screw.

When the hole is recessed the screw is backed out part way and the bar is raised out of the hole, the angle on the back end of the cutter forcing the pin up into place again. A READER.

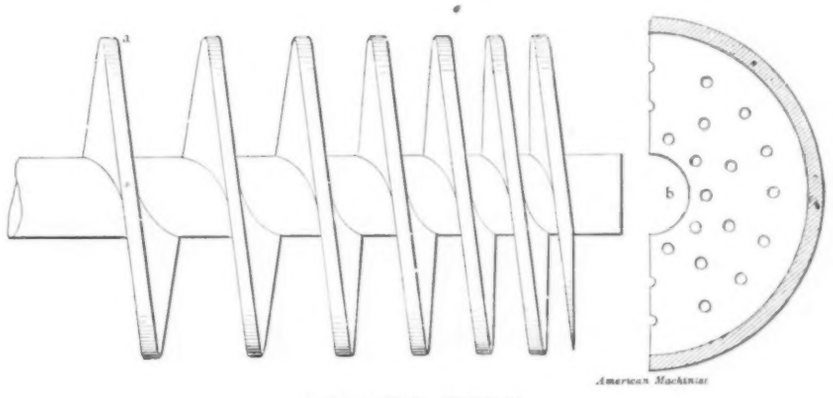


A RECESSING TOOL.

A Compressing Conveyer.

Editor American Machinist:

An ordinary conveyer, as every mechanic knows, is designed solely to carry material from one point to another, and to this use it is generally put. The object of a compressing conveyer, however, is quite different, for this is used mainly to *compress* the material that is put into it. As the material, whatever it may be, is carried along the worm, it at the same time undergoes a process of compression which tends to solidify it. In this feature lies the great value of the contrivance. In the manufacture of certain kinds of confectioners' goods, particularly licorice in various forms, it is found to be indispensable. The dough-like or semi-fluid mixture is allowed to enter at the end *a*, and in moving onward is gradually subjected to pressure, so that when issuing from the other end thru numerous small holes in the head of the shell *b* the material assumes a solid form. As may be easily inferred from the accompanying drawing, this result is secured by the gradually diminishing space between the threads. For hardening mixtures of a dough-like consistency there is nothing comparable to this simple contrivance. As yet comparatively few of these machines are in use, the reason for this being that their existence and value are not generally known.



COMPRESSING CONVEYER.

To build a conveyer such as we have described in the foregoing paragraph is no light task for the patternmaker, for really he is the first man who must needs tackle the job. In a general way, of course, the construction is pretty much the same as in an ordinary worm pattern—that is, the thread is built upon the surface of a shaft after the regulation style. But while the ordinary worm has a single pitch throughout, this one has a constantly varying pitch, gradually increasing the distance between the threads in the direction of the large end. And here really is where the knotty part of the work comes in. With only one pitch, a worm can be easily marked out upon the shaft; but when it happens that the space between the threads is ever changing, a correspondingly new pitch is required at every step. In such a case, nothing remains to be done except to mark the variation on the parting line of the pattern, which of necessity must be made in halves. Then taking a paper templet corresponding in width to the thickness of the thread, each one may be marked out separately. In this way, the increasing

variation in space can be easily and accurately secured.

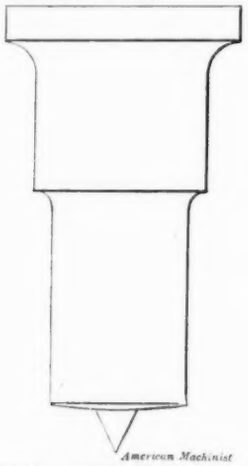
What amount of variation should be allowed between the threads must be left to each man's discretion. But this one point ought to be kept in mind, that whatever the amount of increase decided upon, the same should be carried on uniformly thru the entire length of the conveyer. It is found that such uniformity gives better results.

The accompanying sketch gives a good idea of the conveyer when completed and ready for use, save that an outline of the shell which always surrounds it is purposely milled. The view at *b* gives a fair idea of the appearance of one-half of that end from which the material issues after the compressing process. The tiny holes indicate the openings thru which it comes out. HOMO.

A Punch With Convex Face.

Editor American Machinist:

The usual practise is to make punches for sheet iron with straight faces. I have,



PUNCH WITH CONVEX FACE.

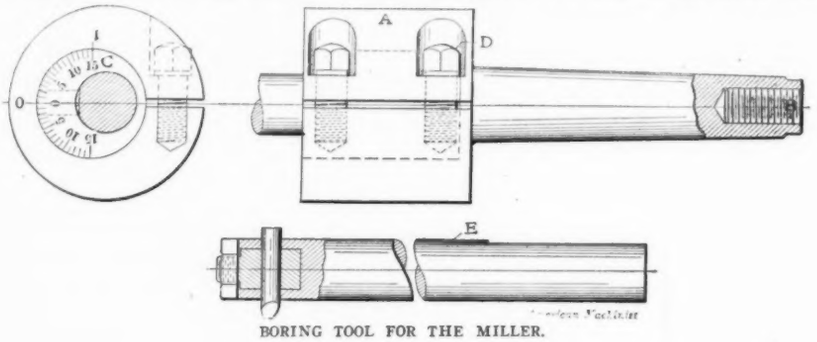
however, found that if the faces of such punches be made slightly rounding, that they will work better and clear themselves better. With punches this shape the stripper has very little work to do.

Muscatine, Iowa. NORMAN.

A Boring Tool for the Miller.

Editor American Machinist:

The boring tool and holder were designed for work on jigs, fixtures, etc. The body *A* is bored eccentric to allow 5-16 inch throw and split on one side. The shank is a Brown & Sharpe taper and can be used in the vertical milling attachment spindle, having the end *B* tapped for the long bolt which draws it up securely. The boring-bar sleeve or bushing *C* is also bored eccentric to allow 5-16 inch throw and turned to fit the body *A* in which it is clamped by screws *D*. Two set-screws hold the boring bar *E* in the sleeve. The end for the cutter is fitted with a stud and a hole then drilled thru for the cutter. The stud is threaded for a nut which, when tightened, clamps the cutting tool. One-half of the face of *C* is graduated, each division being equal to six degrees. Turning the cylinder one-quarter way round gives 5-32 inch throw and half way round



BORING TOOL FOR THE MILLER.

gives 5-16 inch throw, or increases the diameter of a bored hole 5/8 inches. This

Dial Reading.	Increase in diameter from 0-0.	Dial Reading.	Increase in diameter from 0-0.
0– 0	.0000″	1– 0	.3125″
0– 1	.0017	1– 1	.3453
0– 2	.0068	1– 2	.3796
0– 3	.0153	1– 3	.4131
0– 4	.0270	1– 4	.4397
0– 5	.0428	1– 5	.4687
0– 6	.0596	1– 6	.4963
0– 7	.0802	1– 7	.5217
0– 8	.1033	1– 8	.5448
0– 9	.1287	1– 9	.5654
0–10	.1562	1–10	.5822
0–11	.1853	1–11	.5980
0–12	.2119	1–12	.6097
0–13	.2454	1–13	.6182
0–14	.2797	1–14	.6233
0–15	.3125	1–15	.6250

TABLE OF BORING TOOL SETTINGS.

tool can be used in the spindle of the milling machine when fitted with the regular collets. I also send a table showing the increase in diameter from a setting of *o-o* to its greatest throw. A. C. L.

A Handle-Bending Rig.

Editor American Machinist:

Fig. 1 shows a fixture that was used for forming the handle in Fig. 2. This affair was gripped in a movable shop vise that was placed on a block at the forge. Part *A* is gripped in the vise, then the stop *B* is drawn up tight by screws *C*, and this prevents the rig from slipping under the constant hammering. Four or five of the handles are placed in the forge at one time. They are heated to a red heat at *a*, then one is placed in the split bushing *D*, and held tight by drawing up the movable half of the bushing with set-screw *E*, which has a swinging handle *F* attached. While the handle is held thus, a piece of gas pipe is quickly placed over the top and brought down as far as possible, then a half-round swedge is placed at *b*, and by using a medium hammer the handle is brought down straight. After the handles are all bent to this shape they are reheated at *c*, and by means of the hammer and swedge are bent to the shape shown. After doing a few, an apprentice becomes very skillful and can do them quickly without marring them. It requires only two operations to form the handle. *G* is a small screw that holds the loose half of the bushing in place; two small screws *H* hold the other half. *I* is a hole to allow the scale and dirt to fall thru. When these handles were first made, it was found hard work to keep part *d* in line with *e*, so the groove *J* was made in the block, which made it an easy matter. The

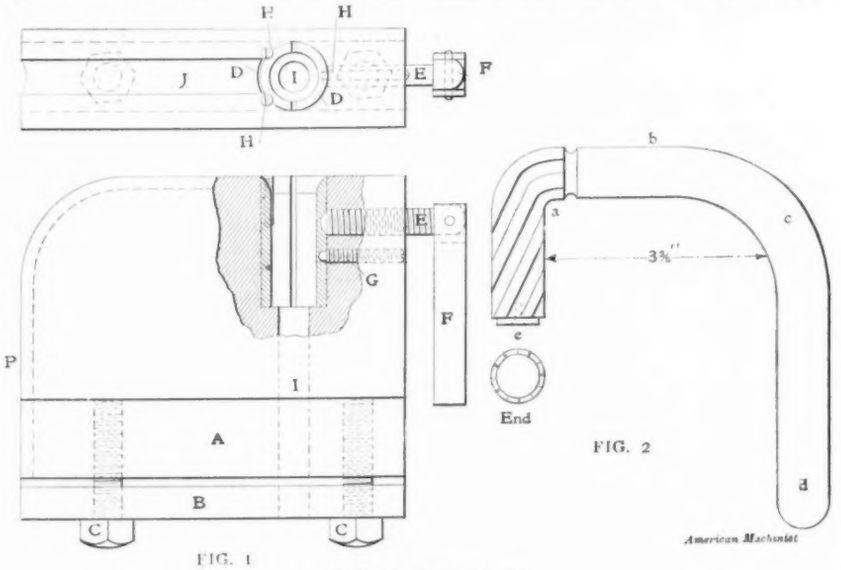


FIG. 1 FIG. 2

A HANDLE BENDING RIG.

handle is made of 5/8 cold rolled stock, has six spiral grooves at one end, and is used on a machine for putting fasteners on gloves, etc. PATRICK J. KING.

Drilling Collars — Duplicate Drilling of Flat Strips.

Editor American Machinist:

The other day we had a lot of collars and eyes or hubs of levers to drill for set-screws, and the sketch shows how we did

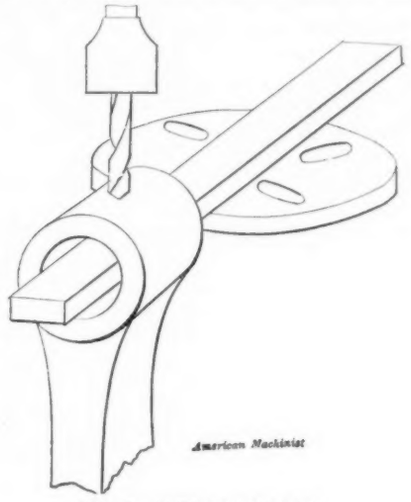


FIG. 1. DRILLING COLLARS.

it. It looks so simple as to be hardly worth telling, but it did the business and the trick cannot be known to everybody, as much more trouble is often taken in drilling collars with results not as satisfactory. The flat bar, Fig. 1, is bolted or clamped on the drill-press table and the collar is slipped loosely on the overhanging end and against the edge of the table. The table is then swung around until the collar is in the right position under the drill and clamped there, and any number of collars may be drilled correctly. They will not roll and will not slide.

In Fig. 2 are indicated the successive

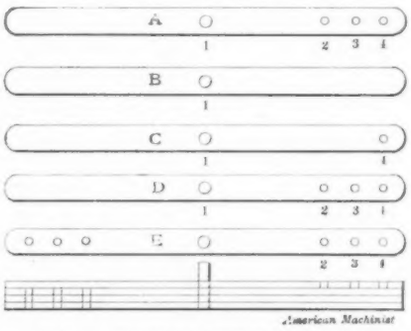


FIG. 2. DRILLING DUPLICATE STRIPS.

operations in drilling, as at *E*, a lot of steel strips. These came to be drilled in lots of 25 to 50, and the holes were required to be in line and equidistant from the center hole within .01 inch. It would not have paid to make a jig because the distances varied in the different lots. We first laid out and drilled holes 1, 2, 3 and 4 in one plate, as at *A*, and then drilled hole 1 in all of them. Plate *A* was then laid on one of the others with a pin in the center hole of both, and hole 4 was then drilled and a pin put in that, when holes 2 and 3 were drilled. All the strips were then put thru this operation, and then they were taken three or four together and drilled on the other end, a pin being first placed in the center hole and another in the end hole as soon as it was drilled, the operation being the same as for the first end. D. W.

Is the Practical Man in Danger?

Editor American Machinist:

In answer to Dixie's letter, at page 1031, I would like to say something about the reverse side of the subject: Is the purely practical man to be "the whole thing" in America?

I was with a large firm manufacturing automobile trucks, and was supposed to have been promoted to the position of chief draftsman and engineer three months after the arrival of a new superintendent, a first-class practical man who was going to put the business in a prosperous condition. About three months thereafter an improvement was intended to be made and the matter was referred to me. After careful consideration I gave my opinion—"impractical for our purposes." The matter was then taken to an outside firm, who, of course not knowing the conditions, submitted something I had considered and discarded. What they suggested, however, is clearly shown in the accompanying sketch.

M is a stationary motor driving gear *G* thru pinion *P*; *C* is a stationary arm securely fixed to axle *A* and carrying brake-band *B*. All goes well so far, but our superintendent conceived the great idea of making the gear and pinion run in an oil-tight casing and suggested to bolt on ring *S* as shown dotted.

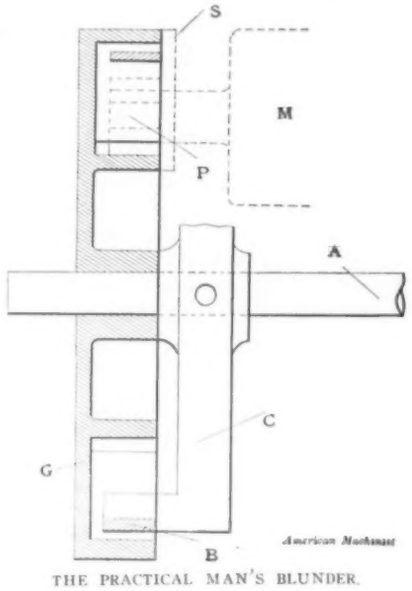
A little while later I was called on the 'phone to be asked, "Is bolt No. 7 or 8 made in the shop or bought outside?" This was when he had been there for over six months.

I recollect another good one: I had been a-walking, or rather a-phoning encyclopedia for some time that day and had just settled down to do some work, when r-r-r-ring went the 'phone. "Mr. X, please step to the 'phone a minute, the superintendent wants to talk to you." "Let me have the horse-power of our motors quick, as there is a customer waiting." Down I sent it in black and white, "The horse-power output at normal current consumption of motor C is so much, of motor B so much, and of motor A so much." I had hardly sat down—r-r-r-ring, the 'phone again: "You have sent me down everything except that for which I asked; give me the horse-power of motor A *with double reduction*." I had a time keeping from roaring at that mouthpiece, but managed to explain—in vain, however (as I must have been so rattled that it was impossible for him to understand me). I then told him that I could give him the increase in load at the reduced speed if that was what he wanted. He replied: "No, I want the horse-power, but send the increase in load down and I will figure the horse-power myself."

Now these are only a few samples out of many, and of course they did me no good, as I was entirely in the wrong. This man was receiving a salary of $4,000 a year, and is now getting even more elsewhere. Should anyone wonder, however, if the business of that concern was decreasing in volume instead of increasing and that the graduate would get blamed? And now the question occurs to me, "Is the practical man or the technical graduate in danger?" H. P. MOORREES.

Editor American Machinist:

In reply to "Graduate's" letter at page 1341, I will tell a little story. Mr. Edison (of electric fame) had in his employment



THE PRACTICAL MAN'S BLUNDER.

two technical graduates, these two men went to work for him about the same time. There was a question raised about the capacity of a certain irregular-shaped tank; so Mr. Edison told each of these men to work out the capacity of the tank, in gallons. When the calculations were finished it was found that the answers did not agree; so Mr. Edison told them to work together, comparing their work as they went along. When the result of their combined efforts was brought to him, Mr. Edison said, "No, gentlemen, your answer is wrong; the correct answer is so and so." "That is impossible," they protested; "we know we are right." "No," said Edison, "you are wrong; this is the correct answer." "And how did you get it, Mr. Edison, that you are so positive?" "Oh," said Edison, "I filled the tank with water and then measured it as I emptied it."

Of course, "Graduate," we cannot all know the same things. I know I am painfully ignorant of many things, but if I got a job where a knowledge of those things

was necessary to my employer's interests and my own advancement, I would certainly not be afraid I would lose caste by asking questions and finding out, while Mr. Robb was. Anyone who knows Dixie knows that he is neither ashamed to ask questions nor afraid to impart what knowledge he possesses to anyone who asks.

DIXIE.

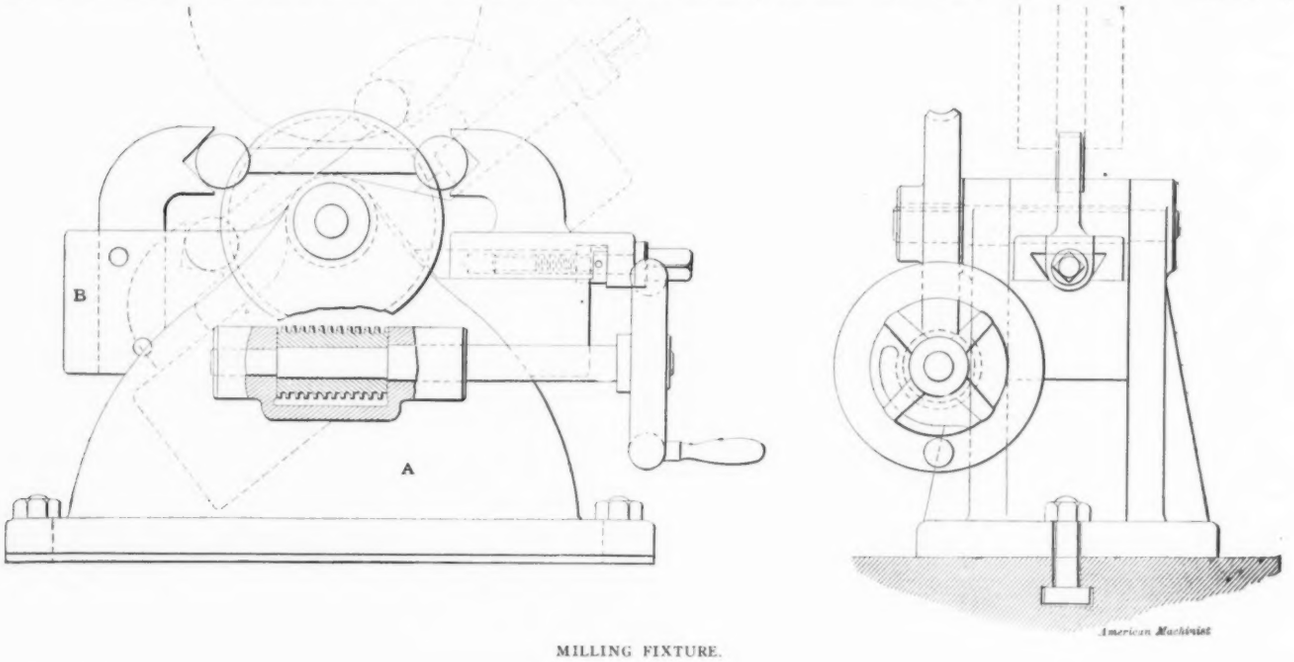
A Milling Fixture.

Editor American Machinist:

This fixture was designed for use upon a hand milling machine, so that one of the "kids" could help out when the heavier class of millers had more work than could conveniently be done upon them, and also to break in the green kid that could not be trusted with these milling machines.

A is a gray-iron casting having two uprights or standards, between which *B* is moved by means of worm and worm wheel, the upper part of the standards being bored, as shown, to receive the worm-wheel shaft, and wheel and casting *B* being keyed to the shaft as represented in the end view. The drop-forged or cast-steel link to be milled is held in the fixture by means of V-jaws made of machinery steel and case-hardened. A slot near the left-hand end and thru the center of *B* admits one jaw, which is forced into place and held by two dowel pins, while the other jaw is formed with a 30-degree dovetail base fitted to *B* and actuated by means of a screw, as shown. The lugs for the worm-shaft bearings are cast upon the side of *A*, together with an oil basin for lubrication of worm and wheel. The worm shaft is operated by a 5-inch hand-wheel keyed upon the end. Dotted lines indicate one end of the link as swung up between the straddle mills and finished. To finish the other end, the movement of the hand-wheel must of course be reversed. The fixture was tongued to the milling machine platen and made a rigid affair.

BECK.



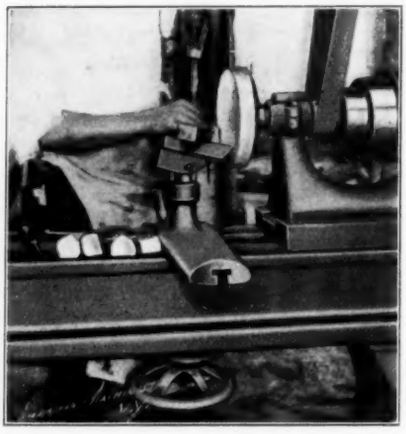
MILLING FIXTURE.

A Home Made Sand Trimmer.

Editor American Machinist:

In our shop we find the arrangement shown in the half-tone very useful for dressing the ends of pieces which cannot be cut on the trimmer. As here shown, a lot of U-shaped lugs are being dressed up and they were done quicker and better than they could have been done by hand besides having a surface all ready for varnishing. This sand trimmer is especially good for the ends of core-prints, which every patternmaker knows to be troublesome. The plate or rest can be tilted and fastened at any angle up or down and a slotted piece on top allows for different angles horizontally. An ordinary wooden face-plate is used with sandpaper shellacked to the face.

J. F. BEHNY.



PATTERNMAKER'S SAND TRIMMER.

Some Babbitting Experiences.

Editor American Machinist:

Among the remembrances of my first years in the shop the experiences I had in babbitting stand out the clearest. I had been working about three years, starting in when I was fourteen as general utility boy, learning a little of everything, and at the end of three years I was the toolmaker's helper. There were about seventy-five machines in the room, and ten of these were old-style grinders, on which nearly every bearing was a babbitted one. I had watched the toolmaker closely when he babbitted boxes, but he would never let me help him. I suppose he wanted to keep all the tricks to himself, as some of the old-time mechanics liked to do.

While he was out on his vacation my chance came. A box gave out on one of the grinders which handled a certain class of work that could not be done on any other, so it was necessary to have it fixed "immediately or sooner," as the boss put it to me. After I assured him that I wasn't afraid to tackle the job, he told me to go ahead and do the best I could. On this machine the screw which moved the wheel to the work was on the back of the machine, and it was the box or nut on this screw which had given out. I have had experience since on different kinds of babbitting, and if there is anything meaner to run than a nut and get a first-class job of babbitting, I would like to see it. The screw was 1⅛ inches diameter, 4 pitch, square thread, and the sleeve that held the babbitt was 8 inches long. I had seen the toolmaker, when babbitting the boxes for the emery wheel shaft, remove them from the grinder and line them up on the platen of the planer, but that couldn't be done in this case, as I soon found out, on account of the peculiar position of the nut, and this increased the

difficulty of pouring it. After plugging both ends of the sleeve with putty, leaving three or four small air holes at each end and having a good size hole to pour into, I prepared to melt the babbitt. In those days the only place we had to heat anything in was the blacksmith shop, down two flights of stairs, and then about 7 or 8 rods farther to the fire, and after getting the babbitt melted, to hike it that distance up the stairs and across the room, opening two heavy doors and then get the box poured before the metal was cool kept a fellow busy. I got it melted in an open ladle and started to run with it, and when I got to the end of the shop I saw that a water pipe had just burst and that a stream was playing all over the door. Well, I wasn't going to stop, so, putting my arm up to shield my face, I made a rush for the door and kicked it open and got thru. I heard the metal hiss and pop as the water struck it, and afterward I found little pellets of babbitt sticking to my jumper. I got to the machine all right and ran an excellent nut, but I have always wondered how I came to have such good luck on the first one.

I don't think I will ever forget another one I poured, quite a while after that, getting another good one. It was a roasting, hot day, too, and I had to work with the sweat running in streams. After I had poured it I had something else to do that was wanted in a hurry. In fact in those days in the old shop they were in a hurry for everything, as they had more work to do than they had machines to get it out on, and whenever a machine broke down it would usually stall the work until it was fixed. I thought I could trust the cleaning-up part to a boy, so, calling one over, I set him to work, and while I was gone he burned his fingers several times. Evidently he didn't know enough to scrape off the hot putty with a stick. Thinking that it would be a great scheme, he poured water on to cool it and shrunk that nut on the screw as tight as if they had been made in one piece. I had to rig a piece of hose from a gas pipe and nearly melt the babbitt out before it would start, and it took nearly two hours before I could get heat enough to start it. After I got thru talking to that boy he had almost decided that he wouldn't become a machinist.

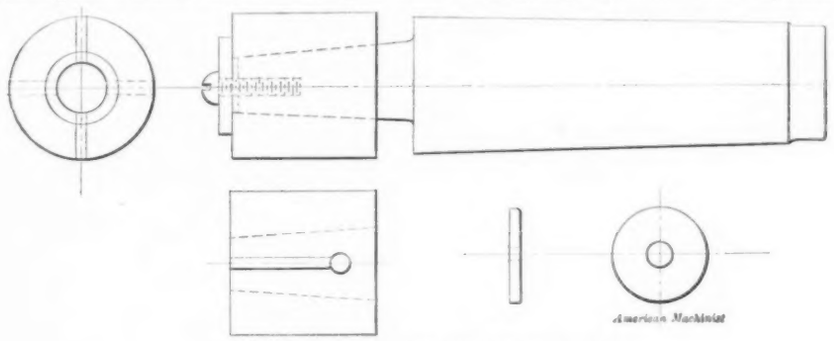
PAUL WESLEY.

Expanding Plug for Cutter Grinding.

Editor American Machinist:

In my experience at grinding, I often came across two cutters, with the holes varying a few thousandths in diameter, and was obliged to make a separate plug for each cutter.

Enclosed I give a sketch of an adjustable



EXPANDING PLUG FOR CUTTER GRINDER.

plug which answers admirably. Bushings of various sizes may be made to fit the same stud.

GEO. J. HUITINK.

Planing Gear Teeth.

Editor American Machinist:

A large cast-steel spur gear had to be planed to mesh into another gear having wooden cogs.

First the gear was accurately spaced and a circle was scribed at the pitch line. A shaft was then procured to fit the bore, then this was mounted on V-blocks on the planer and securely fastened, care being taken to get one tooth exactly vertical.

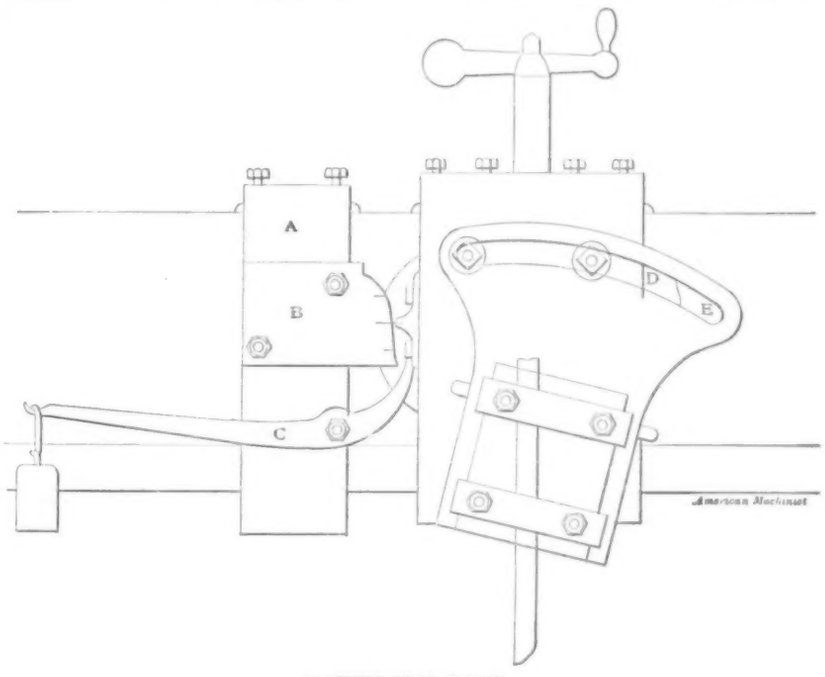
The cross screw of the planer was then removed, leaving the head free. A piece of bar iron *A* was bent to fit the rail and on this was mounted a master tooth *B* having the root, pitch and outside diameter plainly marked. The master tooth was fastened securely to *A* and the latter clamped fast to the crossrail.

On the saddle was placed a small contact piece or shoe with a fine line running thru its center. The lever *C* was then attached and with its fulcrum at the nearest possible point to the head, one end being hooked around a nut at the back of the contact piece, and the other end having a weight suspended to it sufficient to hold the head in contact with the master tooth. All that was necessary to make a perfect tooth was to start the cut when the outside diameter line was in line with the mark on the contact shoe.

To set for the teeth after the first one was cut, a piece of steel bent at right angles, and sharpened to a fine point at each end, was used, the center of the tooth and a fine center-punch mark on the table giving the setting points.

For adjusting the tool, a swivel was placed on the head at the point *D* and a bolt with a hole thru it at point *E;* the two were connected with a screw which allowed the tool either to be pushed toward or away from the tooth being cut. The device gave satisfaction all around.

ALPHEUS.



PLANING GEAR TEETH.

Casting Oil Grooves in Babbitted Bearings.

Editor American Machinist:

R. G. Griswold, at page 1177, gives an interesting method of forming helical oil grooves in babbitted bearings. I was speaking to our machine-shop foreman about the article, and he told me of a somewhat similar way in which he obtained the same results. Instead of wire, he used a twisted lamp wick, first dipping it in oil and then in graphite. The wick was wound around the mandrel and the bearing then babbitted in the usual man-

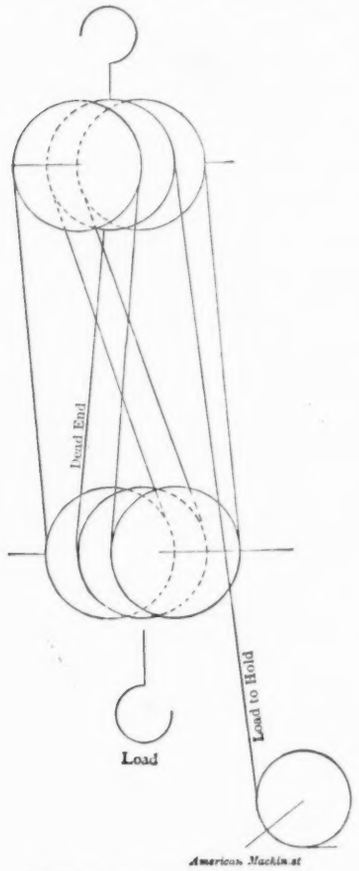
ner. When the mandrel was removed, the wick could be easily pulled out, leaving the helical groove in the babbitt.

A. N. P.

Centralized Pull on Triple Tackle Blocks.

Editor American Machinist:

The sketch shows a method of reeving triple tackle blocks which is not new, but is not generally known among erecting men. Such tackle is frequently strained to the limit, and then it is of great importance to distribute the load as evenly as possible. By the arrangement here shown the lead line is taken off the center sheave instead of the outside one, which is the common practise. This prevents the block



CENTRAL PULL ON TRIPLE TACKLE.

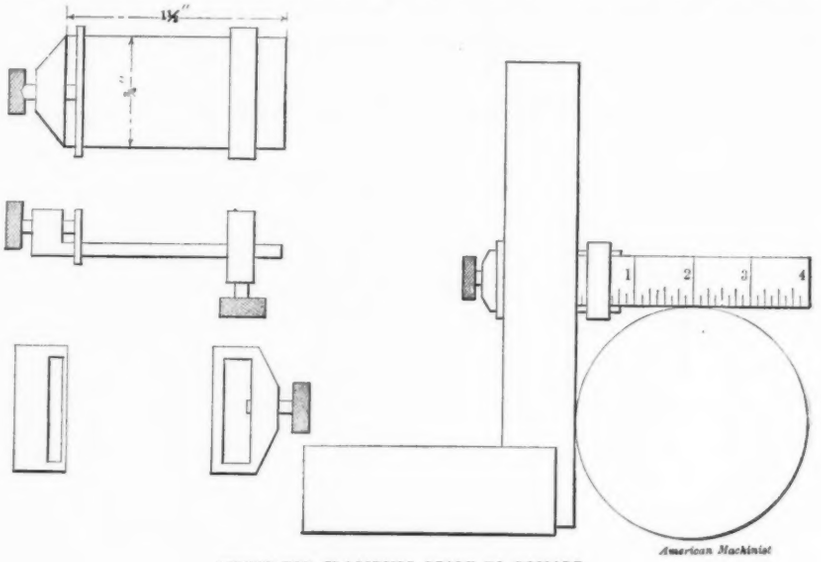
from being pulled askew and goes a long ways toward keeping the straps from being pulled off the rivets.

P. E. ANDERSON.

Device for Clamping a Scale to the Square.

Editor American Machinist:

The sketch shows a little device for holding a scale against a square, a combination which will be found very useful in getting the top center on any round piece to be machined on the miller or the drill press, as well as for various other uses. It is a decided improvement over the old method of taking such measurements, as it occupies only one hand, thereby giving the operator one hand free with which to adjust either work or machine. It has its point of excellence in being adapted to hold any scale up to 6 inches against any square with a blade not exceeding 1 inch in width without defacing



DEVICE FOR CLAMPING SCALE TO SQUARE.

or injuring either scale or square. The dimensions can of course be changed to suit the conveniences of the user.

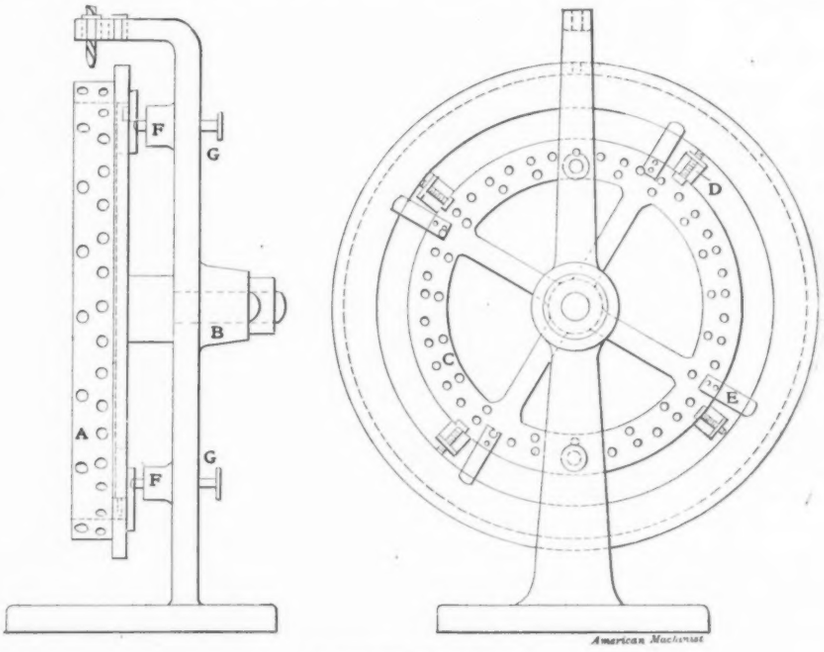
CHRIS.

An Indexing Drill Jig.

Editor American Machinist:

The drawing shows a jig we have been using for drilling holes in a gray-iron ring 4 feet in diameter. There are two rows of holes in this castings, one row spaced 1½ inches, the other 3 inches apart.

The work drilled is shown at *A*. The jig casting, whose foot is bolted to the floor plate of a large drill press, has a hub at *B* which is bored to receive a spindle keyed in a casting *C* that carries the piece to be drilled. *C* and its shaft as they revolve are held back in position by a collar as shown. The four lugs formed integrally at *D* with the carrier *C* are tapped for set-screws, used to center and grip the work. There are also four pieces bolted on at *E*, and against which the casting is pushed when chucking. Two rows of index holes are drilled in *C*, and at *F* are two bosses bored to receive index pin *G*, one pin hole registering with the inner and the other with the outer row of holes in casting *C*. For the outer row of holes in *A* the index pin is used in the upper position; for the inner row, it is placed in the lower boss; and, of course, for this series of holes the jig is shifted to bring the inner guide bushing at the top in line with the drill.



AN INDEXING DRILL JIG.

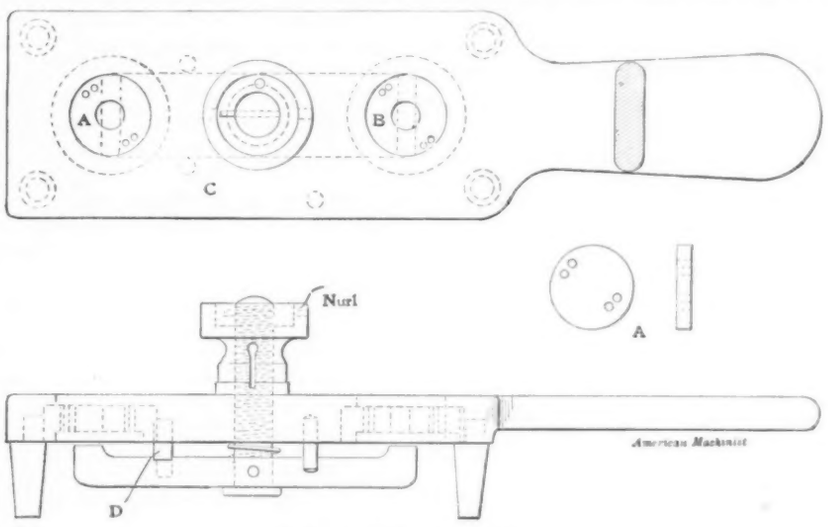
This jig, while very simple, enabled a

man to drill about eight rings per day of ten hours; the best he could do previously was two rings per day. NORMAN.

Drill Jig for Small Disks.

Editor American Machinist:

The sketch is of a jig for drilling the four holes in the steel disks shown at *A*.



DRILL JIG FOR SMALL DISKS.

The jig is made double, two small hardened disks *B* being driven in from the under side and against a shoulder in body *C*, which is machinery steel. The binding nut is of tool steel, sawed in four places, as shown, closed slightly while soft and then spring tempered. The front end is slightly conical to prevent it from spreading.

The operation is as follows: Turn the nut to the left until the clamp comes against the stop-pin and the pin in the top of the nut comes in contact with the pin in the binding bolt. Insert a piece of the work in each end, and by turning the nut the clamp will be thrown into position by the friction of the nut on the stud.

Pin *D* projects 1-64 inch below the clamp when in tightened position to prevent the clamp from turning until it is clear of the work when being loosened. This is a very quick jig to operate, and there are many classes of light work for which a similar jig might be built. W. E. WILBER.

Reform the Figure Nine.

Editor American Machinist:

It has often occurred to me that it was a sad case of brain fag when someone's ingenuity failed him after he had gotten nine characters invented to represent the different numerals and then just turned a six upside down for the tenth. Of course on the printed page you know which side up it is, but get it alone and which is it, 6 or 9? Even on the printed page there is no way of distinguishing it if it happens to get upside down I have seen it on a pattern or casting where no man living could tell which was intended, 66 or 99; or, again, 61 or 19. Both the above cases I have actually seen where one had to go and find out which it was. Any other figure associated with them except naught will tell which side up to read. Also in stamping pieces in the shop many are careless and often get a figure upside down. If it happens to be the fatal 6 or 9—well, that is only a couple of cases out of numbers I have seen where if the 6 and 9 had had different forms it would have been of advantage. Even in the drawing room I sometimes find myself marking off 9 inches instead of 6 when I happen to have my scale upside down, which often occurs.

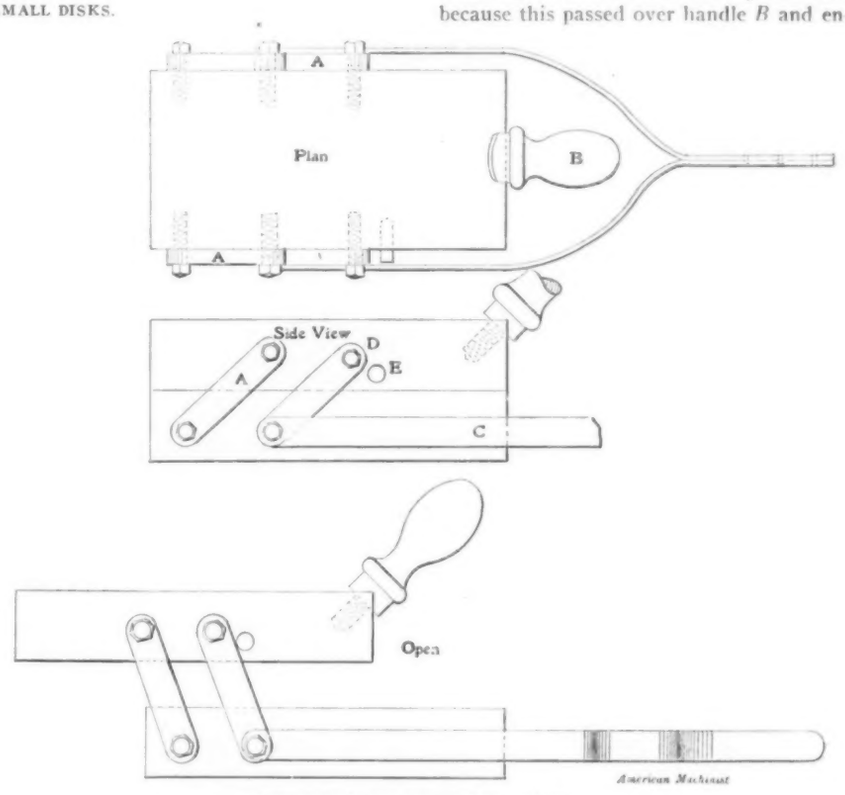
Why cannot the AMERICAN MACHINIST champion a reform and itself set the good example by throwing away all its six's that are turned upside down and adopting a new form on its printed page—preferably, I think, the form generally used in making it with the pen? H. L. W.

Hardening Rig for Small Saws.

Editor American Machinist:

We had been buying our small slitting saws, and as they broke quite often they became rather expensive. The foreman decided to make them in the shop, which was done at far less expense. Some difficulty was found in hardening them, as they were only 13 thousandths thick and 5/8 and 3/4 inch in diameter, and when heated and dipped in oil they assumed all sorts of shapes.

The foreman had a hardening rig made as shown, and which was used with great success. This rig was made of two gray-iron blocks, 6x8x1½ inches, fitted with links *A* on which to swing open. By smearing the inner surfaces of the plates with oil, placing a heated saw between, and bringing the top plate down upon the saw, it became as hard and as straight as could be desired. It was found difficult to open the plates with handle *B*, on account of the oil making them stick; but with handle *C* it became a simple matter, because this passed over handle *B* and engaged with the screw heads *D*. *E* is a pin to prevent the top plate from going back too far. With this arrangement an apprentice could be set to work on the saws and have them come out as nicely as could be desired. PATRICK J. KING.



HARDENING RIG FOR SMALL SAWS.

Trouble in Hardening a Large Die Ring.

Editor American Machinist:

I have had an experience with a large

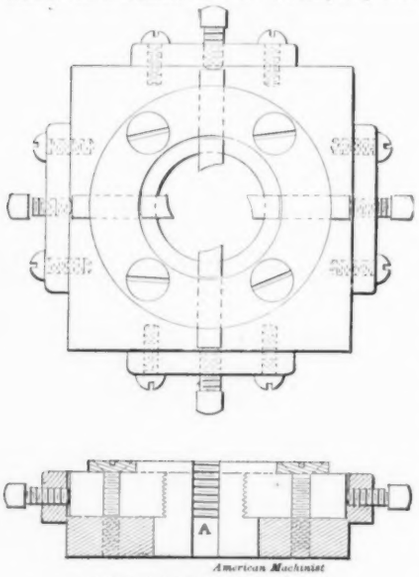
cutting ring which I had been enlarging. The ring, or "cutting edge," as we call it, belonged to a combination die for making a bottom for an oblong tin. The bottom was 10 inches in length by 5 inches wide, the inside of the cutting ring being ¼ inch larger than this all round. I wanted to increase this to 5-16 inch, and therefore the ring was softened and worked out to the size wanted. On rehardening it was found that the ring had shrunk about ⅛ inch. This we could not account for, as the ring was hardened in our usual manner; we have not got a muffle, but use an ordinary coke fire. It was decided to soften it again and work again to the proper size. All the holding-down holes had to be slotted before the screws would go in. After this was done the ring was rehardened and, strange to say, kept its size and shape exact. As I cannot account for it shrinking as it did, I hope some of your workers in steel will give us their opinion.

S——, England. FORMAN.

A Finishing Die.

Editor American Machinist:

This die is gripped in the vise and used for finishing some brass pieces, which are first roughed out in the screw machine or the lathe. The four adjustable chasers are a snug fit in their grooves, are slightly above the surface so as to be clamped down by the ring at the top, and may be adjusted by the four screws. We set the blades to a master tap or a sample piece.



PLAN AND SECTION OF DIE.

This proves a very cheap form of die where there is much work to be finished to size, as one holder does service for the different jobs, and the chasers can be easily replaced. The die is a little by-product of Harrington's, the inventive genius of our shop.

PATRICK J. KING.

An Improvement on the V-Block.

Editor American Machinist:

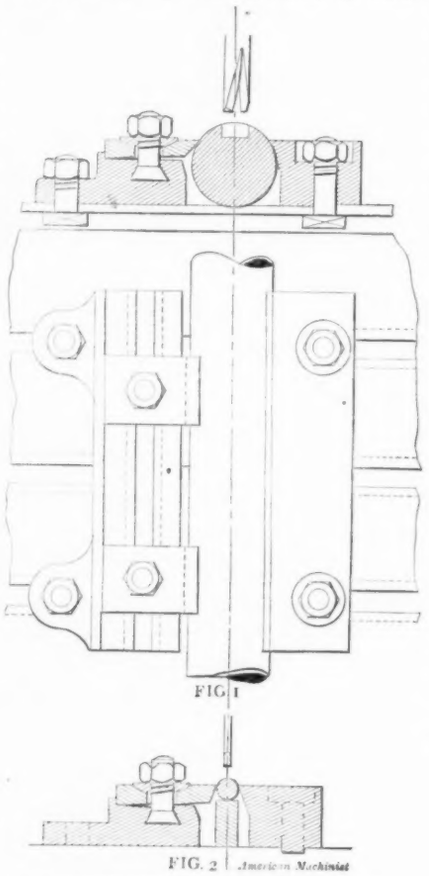
I have noticed at page 1031 the article on "Two Kinds of V-blocks." I have used different kinds, but not any was as convenient as the arrangement shown in the accompanying drawing. Fig. 1 shows the rig for large diameters, Fig. 2 for small ones.

HENRY HEINEMAN.

The Importance of Kinks for Small Shops—Winding Springs—Drilling Hard Tool Steel.

Editor American Machinist:

The articles in a trade publication of most value to the foreman, owner or workman in a small shop are the simple descriptions of short cuts in doing ordinary work. Ideas that are easy to remember are the ones that are stored for future use, and they crop out at the most opportune time and place. We all enjoy reading technical descriptions of the fine points of machine design and construction, and puzzling our brains trying to figure out intricate drawings; but, still, we of the small shop and wide variety of work part with our subscription money more readily after making a few dollars or gaining in reputation as fast workmen by using to advantage an idea taken from some trade paper.



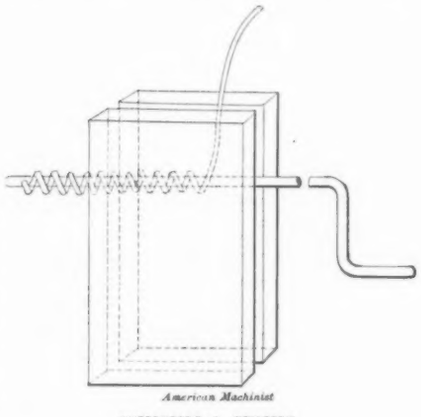
AN IMPROVEMENT ON THE V-BLOCK.

A short time ago I had occasion to plane a T-slot with one end closed. I used a bent planer tool described in the AMERICAN MACHINIST about 1898 for the undercut, with excellent results, as the job was contracted for with the old method of a rigid tool block in view, consequently an additional profit was made on the job.

The accompanying sketch shows a simple, cheap, and effective way of winding coil springs of any pitch and with wire up to ⅛ inch diameter. The materials required are two softwood blocks and a winding mandrel. Take a piece of rod about 1-32 inch smaller than you wish the inside diameter of the spring, bend a crank on one end and drill a hole for a wire inlet; near the other clamp the blocks in the vise with the mandrel in position, small hole up, insert the wire and turn the crank. The pitch can be given by the angle at which the wire is held. When the spring reaches the outside of the blocks it has cut grooves in the wood corresponding to the pitch of the spring. On short springs the pitch can be duplicated, or a spring can be made of any length by opening the vise slightly, pulling back the mandrel and clamping the spring to the mandrel with a lathe dog. In this way springs can be made by a boy or helper without tying up a lathe or drill press. This sometimes means much in a small, busy shop. Springs made this way acquire a nice polish.

Many a machinist has spoiled his chances of a soft berth in the Hereafter by a superfluous use of profanity—to say nothing of all the cooling liquids, such as turpentine, soap water, etc., known to him—while trying to drill a piece of hard tool steel by using a very slow speed. He will have the power slowed down still further, but, alas! with no better results than keeping the emery wheel hot grinding the drill. Now, my dear brothers, the point in drilling hard steel is—the point of your drill. It has to cut before the lip, so speed up your drill until the point cuts instead of flattening and you will have much less trouble. I prefer drilling tool steel dry, cooling the drill in a can of water before hot enough to draw the temper. This, of course, does not apply to drills made of high-speed steel.

YANK.



WINDING A SPRING.

Heavy Lathe Cuts With High-Speed Steel.

Editor American Machinist:

As reports of phenomenal performances on the part of tools made of new high-speed tool steels are generally received with more or less interest in this, the day of high-speed steels, I enclose herewith two photographs showing the opposite sides of a very large chip taken from a

forging of high carbon steel on the second cut.

The machine used was an 84-inch lathe driven by an independent motor. A roughing cut had been run over the piece so that the tool might have clean metal to work in. The roughing cut reduced the piece to 40 inches in diameter at the place where the trial was to be made.

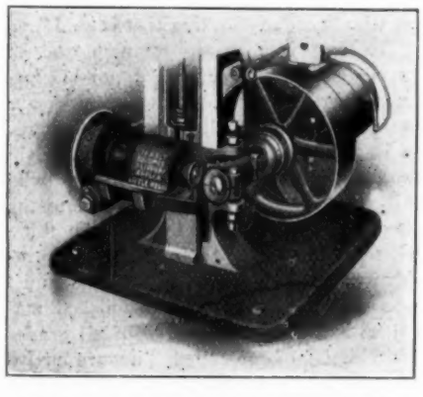
In order that the tool might be tested under various trying conditions, several speeds were used with varying feeds, but this chip was taken at a maximum speed of 5 revolutions per minute; the resulting periferal speed was 52.3 feet per minute and the mean cutting speed slightly less. The feed was increased to ⅜ inch and the depth of cut was 1⅞ inches, reducing the piece 2¾ inches in diameter per cut.

The tool was a dull red during the cut, and the chip is a beautiful greenish-blue throughout. One peculiar condition shown on the chip is the "crowding" of the metal until it has begun to flow. This flow is shown on the concave side of the chip and resembles in appearance the form taken by the surface of furnace slag when it has been turned out to cool, the upper crust generally solidifying in well-rounded ridges.

The chip is ⅜ inch thick and 1⅞ inches wide. The picture shows a series of fractures which extend only part of the way across, the remainder being good, solid metal. The edge of the tool became much rounded during the cut, and as soon as it was touched to the wheel for re-sharpening, crumbled into small fragments and it was necessary to grind down to new metal before a good cutting edge was secured.

R. G. GRISWOLD.

[The photographs received with this letter are very interesting, showing the flowing action mentioned, but are not reproduced, as it is doubtful if this point would be brought out satisfactorily in the engraving.—Ed.]



CORNER OF MACHINE BROKEN IN TRANSPORT.

Careless Handling of Machines in Transport.

Editor American Machinist:

We were quite interested in the letter at page 1166, describing the breaking of a vertical milling machine shipped by the Brown & Sharpe Manufacturing Company. We were shipping a chain saw mortiser for export, and in New York it was found broken, curiously enough, in exactly the same manner as the Brown & Sharpe machine, the right-hand front corner being knocked off, as indicated on the cut of the machine and the sketch of fracture herewith. The machine was protected on a plan similar as to packing to that described in your article, and we are at a loss to account for the breakage, especially, as you will note from the sketch, there is

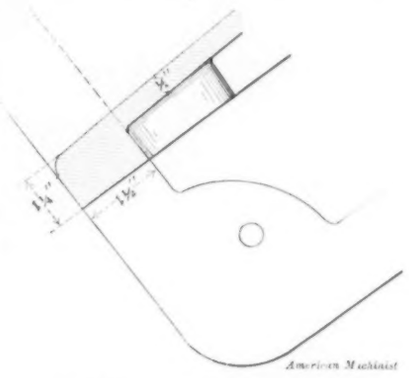


DIAGRAM OF THE BROKEN CORNER.

ample metal in the base to sustain the weight of the machine under all normal conditions. In fact, as an example of the endurance of this style of mortiser under trying conditions, we have often quoted the circumstance of one's falling from the second story to the basement, in a fire in Winnipeg, without being damaged at all.

THE NEW BRITAIN MACHINE CO.
ROBERT S. BROWN, Sec'y.

Machine Tool Builders' Association Meeting.

The next convention of the National Machine Tool Builders' Association will be held in New York city, with headquarters at the Hoffman House, November 15 and 16. With the notice of the meeting, Secretary P. E. Montanus sends a copy of his address delivered at the Cincinnati meeting showing the work accomplished by the association and a list of the membership, as follows:

The Hendey Machine Company, Torrington, Conn.
B. F. Barnes Company, Rockford, Ill.
Detrick & Harvey Machine Company, Baltimore, Md.
Baush Machine Tool Company, Springfield, Mass.
Blaisdell & Co., P., Worcester, Mass.
Draper Machine Tool Company, Worcester, Mass.
Prentice Bros. Company, Worcester, Mass.
Reed Company, F. E., Worcester, Mass.
Whitcomb Manufacturing Company, Worcester, Mass.
Woodward & Powell Planer Company, Worcester, Mass.
Norton Emery Wheel Company, Worcester, Mass.
Sutton Company, C. E., Toledo, Ohio.
Flather & Co., Inc., Nashua, N. H.
Flather Planer Company, Mark, Nashua, N. H.
Binsse Machine Company, Newark, N. J.
Gould & Eberhardt, Newark, N. J.
Davis Machine Company, W. P., Rochester, N. Y.
Wilson Machine Company, W. A., Rochester, N. Y.
The American Tool Works Company, Cincinnati, Ohio.
Bradford Machine Tool Company, Cincinnati, Ohio.
Bickford Drill & Tool Company, Cincinnati, Ohio.
Cincinnati Machine Tool Company, Cincinnati, Ohio.
Cincinnati Milling Machine Company, Cinnati, Ohio.
Cincinnati Planer Company, Cincinnati, Ohio.
Cincinnati Shaper Company, Cincinnati, Ohio.
Dietz Machine Tool Company, Cincinnati, Ohio.
Fosdick Machine Tool Company, Cincinnati, Ohio.
Greaves, Klusman & Co., Cincinnati, Ohio.
Hisey-Wolf Machine Company, Cincinnati, Ohio.
Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.
LeBlond Machine Tool Company, R. K., Cincinnati, Ohio.
The King Machine Tool Company, Cincinnati, Ohio.
The Queen City Machine Tool Company, Cincinnati, Ohio.
Rahn, Mayer, Carpenter Company, Cincinnati, Ohio.
Schumacher & Boye, Cincinnati, Ohio.
Hamilton Machine Tool Company, Hamilton, Ohio.
Fairbanks Machine Tool Company, Springfield, Ohio.
Springfield Machine Tool Company, Springfield, Ohio.
Owen Machine Tool Company, Springfield, Ohio.
Jones & Lamson Machine Company, Springfield, Vt.
The Ridgway Machine Tool Company, Ridgway, Pa.

A shipbuilding race between the Brooklyn and the Mare Island Navy Yards has just begun. Each yard is to build a naval collier authorized by the last Congress. These colliers are to be the largest and fastest of their class in the world. Each will be about 500 feet long and will cost about $1,250,000. For the collier at the Brooklyn yard the ways and cranes used for the battleship "Connecticut," recently launched, will be put into service again.

The issue of the *Patent Office Gazette* for October 25, which is unusually bulky, contains twenty-six patents relating to cash registers and assigned to the National Cash Register Company. The applications for some of these patents date as far back as 1897.

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Contents.

	PAGE
The Siemens-Schückert Works in Germany—Nuremberg	1453
The Inventions of a Single Lifetime.	1455
Large Micrometer Calipers at the British Westinghouse Works	1460
Echoes from the Oil Country—Reducing Friction	1461
The Technical School as the Royal Road	1462
Experience with the Premium Plan	1463
Molding a Compound Gear on a Stripping Plate Machine	1464
Incessant Supersession in Engineering	1466
Welding Spokes Into a Cast-Steel Locomotive Driver	1466
"Pneumatic Belting"	1467
The Machine Shop and the Home—IV	1467
The Influence of Specifications on Commercial Products—Soap as an Illustration	1468
Letters from Practical Men	1469-1485
Machine Tool Builders' Association Meeting	1485
The Subway	1486
Non-Productive Labor in Manufacturing	1486
American Society of Mechanical Engineers—List of Officers Nominated and Program of Annual Meeting	1487
The Metric Movement in Canada	1487
Some New Things	1488
A Railway Speed Story	1490
The Workman	1490
Technical Publications	1490
Personal	1491

The Subway.

The completion of a large portion of the New York subway, and the beginning of the running of regular passenger trains which are nevermore to stop day or night compels thought and gives opportunity for remark upon numerous and diverse lines. Whatever may be said there is still vastly more unsaid. There is no need to magnify the work. It is another prominent landmark in the history of the world's engineering, and this not only in itself as a complete and self-contained whole, but in that "stupendous whole" as still only the precursor of vastly more work already in sight and under way or suggested in the same line. Already in New York and its immediate vicinity none is wise enough to say where shall be the limit of subterranean and submarine transportation. More subways are being demanded, tunnels are being pushed under the Hudson and under the East rivers and across Manhattan, and one of the world's great railways is to operate its Metropolitan station far below the surface.

It is marvelous how closely now the engineering world in its practical work is crowding upon and immediately availing itself of its successively revealed opportunities. It is doing continually, and in many lines, work which it would have been impossible to have done in the same way and by the same means and, what is quite as important, at anything approaching the same cost, only a decade ago. See the aluminum that forms so much of the interior of the steel cars; where was that a decade ago? Where were all the details of the material and construction of the steel portion of the cars ten years ago? A still more important factor in quickening and cheapening the construction has been the enormous use of concrete, and that also has developed in the last decade. Most of the details of electric power transmission that have made it practicable for such vast and responsible lines of work have also developed very recently. The use of compressed air, another important helper in the construction of the subway, goes only a little further back. Other items of newness in means, materials or methods will suggest themselves and we need not try to enumerate them. Some things long familiar in large engineering work have dropped out of sight within a decade or so. Alas! for the poor old wheelbarrow; who saw it on the subway job? This immediate seizing of every device, invention, discovery that promises to be helpful and putting it at once to work, may be called, in a way, "hand-to-mouth" engineering; but, if so, then hand-to-mouth is no longer a phrase of reproach, but rather of the highest commendation.

To those who kept at all in touch with the progress of the subway construction one of the most remarkable particulars, as revealed to every looker on in the progress of the work, was the precision and completeness of the planning. There was no "cutting and trying" about the job and no doing of things over again because they had not been entirely studied out and because that which might have been foreseen and planned and provided for had been overlooked. It was evident all thru that the real, responsible, time-saving, money-saving work was done in consulting and drafting rooms and not by men standing upon piles of upheaved earth. The work in its entirety depended upon very diverse skill for the different portions of it, and the preparation of the different parts was absolutely independent the one of the other until co-ordinated and connected in the completed system. The driving of the tunnel thru Washington Heights had nothing to do with the setting of the boilers in the power-house, yet both had to be done and to be both ready together, and all these things have come out so nearly together that none can say which waited for the other. The building of the subway is all thru a great trophy of *modern* engineering.

Non-Productive Labor in Manufacturing.

Technical literature is full of references in one way and another to non-productive labor, and the work of draftsmen, patternmakers, clerks, etc., is quite commonly regarded as being "non-productive." It is unfortunate that the term was ever invented; it is misleading and deceptive and ought never to be used in connection with any labor employed about a manufacturing establishment, so long as such labor is necessary to carry on the establishment or is employed to advantage in carrying it on. It is rather surprising indeed that those who use the term so freely have never applied it to foundry laborers who shovel sand and do other work of vital necessity about foundries, yet who "produce nothing that is sold."

The fact is that anyone employed in any capacity whatever about a manufacturing establishment, whose services are useful to that establishment, contributes to its product and is actually engaged in productive labor. The teamster who brings castings and other material to the shop door, and who really *makes* nothing whatever, is just as truly engaged in productive labor as is the erecting machinist who sets up and starts the finished machine; and the same is true of all grades and kinds of so-called "nonproductive labor." There are plenty of shops in this country to-day, and more of them in other countries, which are run upon old-fashioned, slip-shod methods, or no method at all, and in which so-called "non-productive labor" could be employed in the form of intelligent supervision, inspection, stock-keeping, drafting and systematizing, with the effect of greatly increasing production and reducing costs. Would not such labor be as truly productive as any now employed in the same shops?

Patternmakers are often looked upon as non-producers. If they are, then why not

discharge them all, close up the pattern shops and produce castings without them? The attempt to do this would soon convince the "nonproductive labor" faddist that patterns, and therefore patternmakers, are vitally necessary to the production of castings, and that therefore the labor of the patternmakers is just as truly productive as that of the molders.

Anyone who speaks of non-productive labor about a manufacturing establishment should show how such labor may be dispensed with or should cease to use the term.

Manufacturing establishments cannot be operated without the employment of men whose hands seldom, if ever, touch any part of the product that is sold. Until they can be so operated, all such labor is productive and not in any sense non-productive. The misused term is often distinctly in the way of a clear understanding between superintendents and their employers. An employer—a good business man perhaps, but knowing nothing of manufacturing operations—seldom thinks of classing his bookkeeping and clerical force as "non-productive," "necessary evils," etc. He knows the necessity for them and accepts it without question; but he is often disposed to grumble at the number of patternmakers, draftsmen, inspectors, foremen, etc., because he has heard these classed as "non-productive" and he is always considering the "percentage of non-productive labor" and the possibility of reducing the percentage; often without taking the trouble to find out, as he easily might, that the greater percentage of "non-productive labor" results in decreased cost of finished product, which, after all, is the thing he wants or should want.

Toolmakers are just as truly non-productive as patternmakers. We know of a factory where one toolmaker was employed; a new superintendent came in and immediately employed five toolmakers. Thus he increased that particular kind of non-productive labor 400 per cent. But the toolmakers were nevertheless advantageously employed; their work resulted in greatly decreased costs throughout the entire factory, and no equal number of men could have been employed in any other capacity whatever whose labor would have resulted in so much increase of quantity and improvement in quality of work. It was absurd to regard those toolmakers as "non-producers," yet the proprietor, one of whose fads was keeping down the "percentage of non-productive labor," did call them non-producers and harped so much upon the increase of non-productive labor and refused so persistently to consider the improved quality, increased quantity and decreased cost of product that the new superintendent grew tired of his foolishness and accepted another place.

The term "non-productive labor" ought never to have been invented. It means nothing definite, and is misleading and confusing. Its use should be discontinued in all discussions of cost systems and elsewhere. It can only help in causing misunderstandings and trouble. It should head the list in the engineering *index expurgatorius*.

But a short time remains within which one may visit the St. Louis Exposition. It is well worth seeing, and everyone who can conveniently visit it and is intelligent enough to appreciate what it means and stands for will find it well worth while. Especially is this true with respect to those who have seen none of the modern great expositions. To such St. Louis will prove a revelation and may easily contribute in an important degree to the sort of education one gains by intelligently seeing things—an education none of us can have too much of.

American Society of Mechanical Engineers—List of Officers Nominated and Program of Annual Meeting.

The following is the list of officers for the ensuing year as prepared by the nominating committee of the American Society of Mechanical Engineers and to be voted upon by the members:

For president—John R. Freeman, Providence, R. I.

For vice-presidents—S. M. Vauclain, Philadelphia; H. H. Westinghouse, Pittsburg; Fred W. Taylor, Philadelphia.

For treasurer—Wm. H. Wiley, New York city.

For managers—George M. Brill, Chicago, Ill.; Fred J. Miller, New York city; Richard H. Rice, Lynn, Mass.

Preliminary announcement is made of the coming annual meeting as follows: The headquarters of the Society will be as usual at the Society house, 12 West Thirty-first street, and the opening session will occur on Tuesday evening, December 6, at 9 P. M. President Ambrose Swasey will deliver the annual address, the subject being "The Achievements of the Engineer with Respect to Exact Measurements." The second session will occur on Wednesday morning at the hall of Mendelssohn Union, 113 West Fortieth street, at 9.30 o'clock. This will be the business session of the convention and the following professional papers will also be presented: "A New Hydraulic Experiment," by A. F. Nagle; "A Twist Drill Dynamometer," by W. W. Bird and H. P. Fairfield; "Diamond Tools," by Gus C. Henning. Following this, luncheon will be served at the Society house.

The third and fourth sessions will take place at Mendelssohn Union, Thursday morning and afternoon respectively. At the morning session the following professional papers will be considered; A. J. Bowie, Jr., "'Centrifugal Fans"; Charles T. Main, "Computation of Values of Water Powers and Damages Caused by Diversion of Water Used for Power"; Chas. E. Sargent, "An Indicating Steam Meter"; Robert S. Hale, "Staybolts, Braces and Flat Surfaces: Rules and Formulas"; George I. Rockwood, "Condensers for Steam Turbines."

At the afternoon session the professional papers will be as follows: "Bursting of Four-Foot Flywheels," by Charles H. Benjamin; "Influence of the Connecting Rod upon Engine Forces," by Sanford A. Moss; "Losses in Non-Condensing Engines," by James B. Stanwood; "Power Plant of Tall Office Buildings," by Stirling H. Bunnell; "Pressures and Temperatures in Free Expansion," by A. Bordody and R. C. Cairncross (presented by Charles E. Lucke). Between the morning and afternoon sessions luncheon will be served at the Society house. The usual reception for guests and friends will be held at Sherry's on Thursday evening at 9 o'clock and will be followed by dancing and supper.

The closing session will be held at the Society house on Friday morning, December 9, at 10 o'clock. Following are the professional papers that will be considered: "Fuel Consumption of Locomotives," by George R. Henderson; "Road Tests of Brooks Passenger Locomotives," by E. A. Hitchcock; "Discharge of Water with Steam from Water Tube Boilers," by A. Bement; "More Exact Method for Determining the Efficiency of Steam Generating Apparatus," by A. Bement; "Forcing Capacity of Fire Tube Boilers," by Francis W. Dean.

The Metric Movement in Canada.

The Commercial Intelligence Committee of the Canadian Manufacturers' Association included in its report at the annual meeting of the association in September the result of a poll of the members of the association on the adoption of the metric system in Canada, as follows:

"This important subject has received the close attention of your committee. Its importance must be admitted in view of the fact that a bill to legalize the system as the standard in Great Britain was recently carried thru the British House of Lords and that the Canadian Government has recently given some thought to its introduction in Canada. A detailed inquiry made by this committee among the members of the association shows the following results:

Inquiries issued	1,427
Replies received	493
In favor of adoption of the system	219
Against the adoption	225
Indifferent to	49

"This would indicate that the majority of the members are not at all interested in the question. Of those who replied, the greater number opposed it and the views of these must receive due consideration. In any case, the results of this investigation lead your committee to recommend that this association should not endorse the adoption of the system in Canada until it is simultaneously adopted in the British Empire and in the United States."

Some New Things.

A BALL BEARING SENSITIVE DRILL.

The accompanying engravings illustrate a sensitive drill press possessing a number of novel and interesting features, one of which is a series of ball bearings for all running parts (except for the spindle where it passes thru the quill), thus admitting of very high speeds with a minimum of friction and wear. Another feature of importance is a balanced roller key drive, which, in connection with a stem carrying the spindle pulley independently of the spindle itself, relieves the latter of undue strain and allows it to be fed very easily even under heavy duty. Still another valuable feature is the provision for four speeds thru the medium of a pair of two-step cone pulleys, two self-alining idlers carried by adjustable brackets taking care of the belt and keeping it under the proper degree of tension no matter which steps it may be operating on.

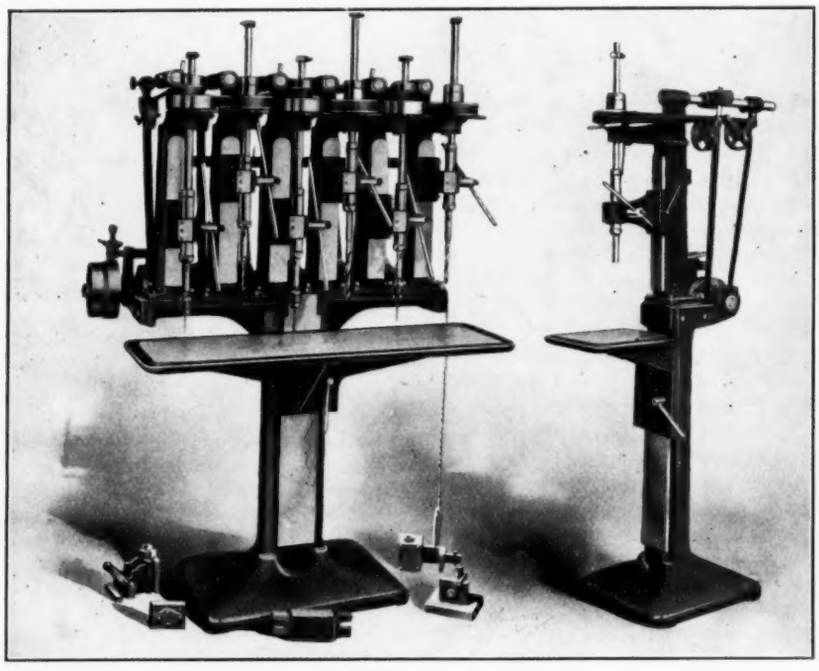


FIG. 1. BALL BEARING SENSITIVE DRILLS.

This drill is built with from one to six spindles, the mechanism being precisely the same in all cases, therefore in Fig. 1 are incorporated a view of a single and another of a six-spindle machine. A ⅞-inch spindle is used in all machines, and the belt from the driving shaft at the rear to the pulley on the spindle is in each instance 1¼ inches wide and cemented; the driving belt for the rear shaft is also but 1¼ inches wide. The countershaft or back shaft and its bearings are arranged as shown in Fig. 2, and it will be noticed that ball bearings are provided for the loose pulley as well as for the shaft. The cone for the spindle belt is adjustable on the shaft and, when the belt is to be changed from one step to the other, may be shifted by means of a key, to allow the belt to lead properly over the idlers. By referring again to Fig. 1, it will be seen that the inner of the two idlers is adjustable vertically to deliver the belt to either step of the spindle pulley, while the rear idler is adjustable horizontally to maintain the required belt tension.

The spindle drive will be understood from Fig. 3, which shows the upper portion of the spindle where it passes thru the cone. The latter with its ball bearings is supported by a hollow stem with slightly enlarged bore at the upper end, admitting the spindle freely and relieving it of strain due to belt pull, and has at the top the roller driver referred to in the opening paragraph. This member is screwed fast in the upper end of the cone and carries two rolls whose periferies engage the spindle in the manner indicated, the grooves for the rolls being milled exactly opposite each other. This arrangement balances the drive on the spindle and allows the latter to be fed with little frictional resistance from the rolling keys. The small rectangular block shown in this drawing near the top of the spindle acts as a stop or depth gage; the long pin under the pulley is a support for the belt when setting the idlers. In the drills having more than one spindle this pin is replaced by a rod running the full length of the machine and serving to support the belt for any spindle which is not in use and whose tension idler is therefore relaxed.

The spindle is made straight from end to end and then fitted with a ball thrust collar which is shrunk in place. Adjustment for end play in the rack sleeve (which sleeve is grooved spirally right and left hand to insure ample lubrication) is effected by a pair of threaded members above the sleeve, and one of which is pinned fast to the spindle while the other, in the form of a nut, is adjusted as required upon the threaded hub of the fixed member and locked with a small screw upon a binder shoe. The spindle speeds vary—with a driving shaft speed of, say, 800 turns—from 600 to 2,025 turns per minute, the increment of increase being practially 50 per cent., thus giving intermediate speeds of approximately 900 and 1,350 rotations per minute with a countershaft speed as above. The lower two speeds, or those for the larger sizes of drills, are derived with the belt on the large diameter of the spindle pulley, the change from lowest to second speed being made by means of the rear pulley. The higher two speeds—

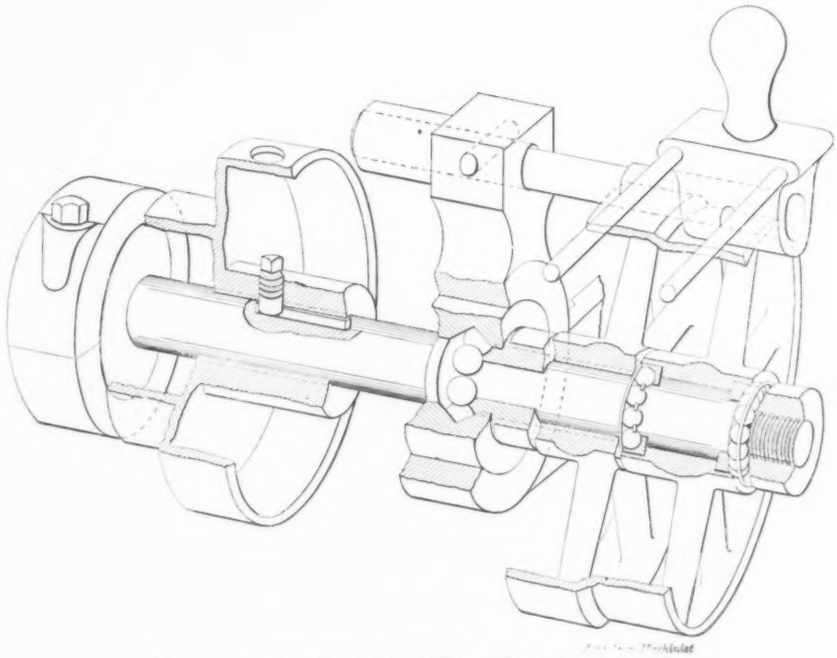


FIG. 2. ARRANGEMENT OF DRIVING SHAFT AND BEARINGS.

used, of course, for the smaller drills—are therefore obtained with the belt operating on the small step of the spindle pulley.

That this driving scheme which gives speeds high enough for the smallest of drills is highly satisfactory for a class of work ordinarily handled in drill presses much heavier than the sensitive type is shown by the fact that the machine will with ease drill holes as large as ¾ inch in gray iron or steel. And some of the results obtained in conjunction with drills

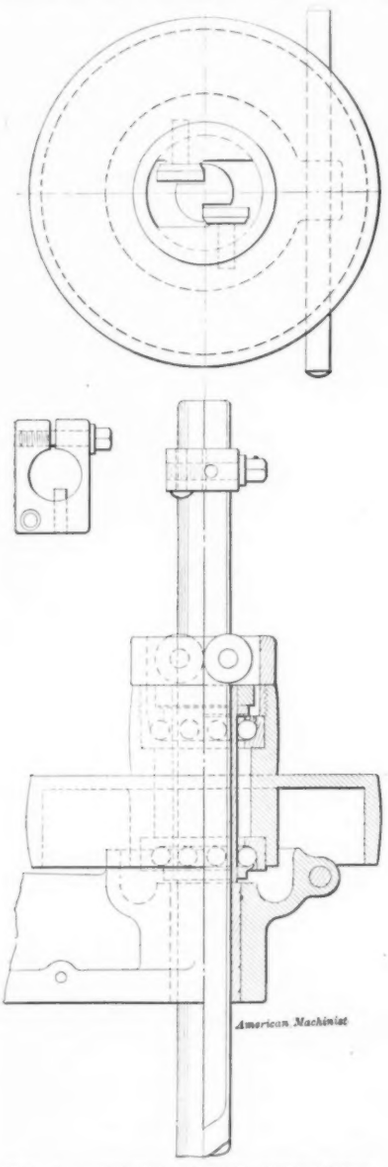
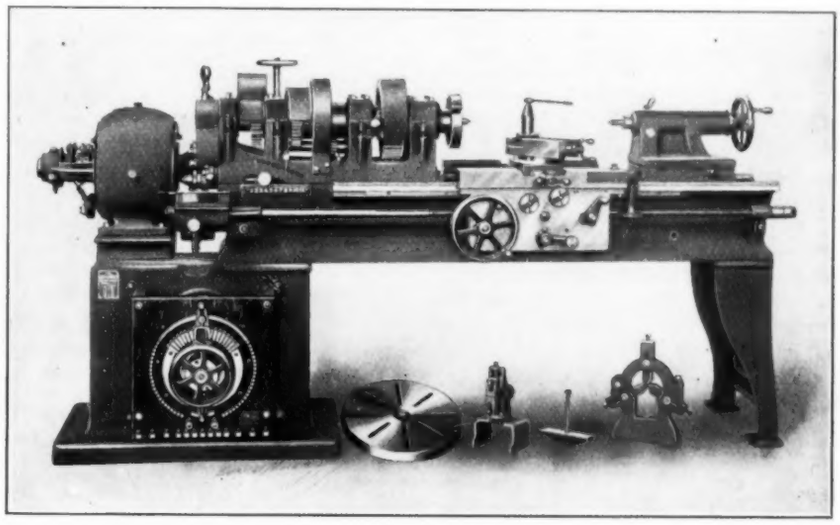


FIG. 3. SPINDLE DRIVING MECHANISM.

of high-speed steel are indeed remarkable. During some tests recently made in the writer's presence, a ¼-inch Novo drill running at about 1,930 turns per minute drilled five holes thru a 1¼-inch gray-iron block in 30 seconds; a 5-16 inch drill running at the same speed was put thru the same block five times in 35 seconds; a 7-16 drill at 1,350 turns drilled five holes thru the 1¼-inch gray iron in 45 seconds, and a ½-inch drill—like the above, of Novo steel—drilled five holes 1¼ inches deep in 48 seconds, the speed still being 1,350 turns per minute. A ⅝-inch drill of Styrian "White Label" steel was run thru the 1¼-inch piece five times in 54 seconds at a spindle speed of 1,350. Then with a ¾-inch Novo drill running at 820 turns, five holes thru 1¼-inch gray iron were drilled in 1 minute 40 seconds, or 20 seconds each. The same drill was then used on machine steel 2 inches thick and at 820 turns per minute, drilled a number of holes thru the bar at an average speed of 1 minute each. At no time during this interesting exhibition did the belt slip or the machine show indication of beng overworked in the least degree. It will be apparent from the foregoing that this drill press is well adapted to get the best possible results from the drills made of the new high-speed steels.

The spindle of the drill has a 5-inch feed by means of the rack and pinion and, by dropping or elevating the head, a 13-inch movement. The distance from the spindle center to the column face is 7 inches, and where two or more spindles are provided the center distance between spindles is 7 inches. The greatest distance from table to spindle end is 32 inches.



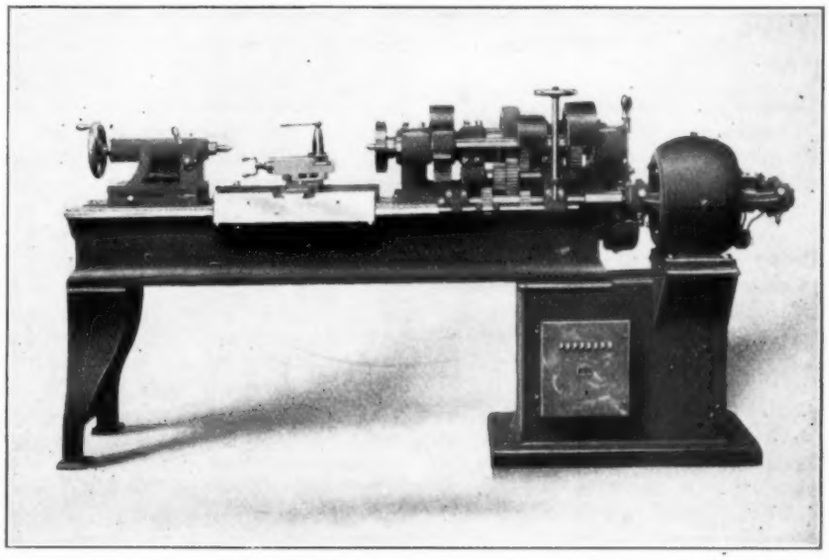
16-INCH MOTOR-DRIVEN LATHE.

The hole in the spindle is No. 2 Morse taper.

The inventor of this drill press is C. D. Rice, and its builder is the Henry & Wright Manufacturing Company, Hartford, Conn.

MOTOR-DRIVEN LATHE.

The half-tones show the 16-inch lathe of the Lodge & Shipley Machine Tool Company, of Cincinnati, Ohio, as equipped with a new headstock, which has all the advantages of their new head—fully described at page 834—and is driven by a variable-speed motor having a speed range of 2 to 1; this, in connection with the three speed changes in the head itself and the two changes in the driving shaft (or a total of six mechanical changes), giving a wide range of speeds for the spindle. The gearing and controlling handles for obtaining the speed

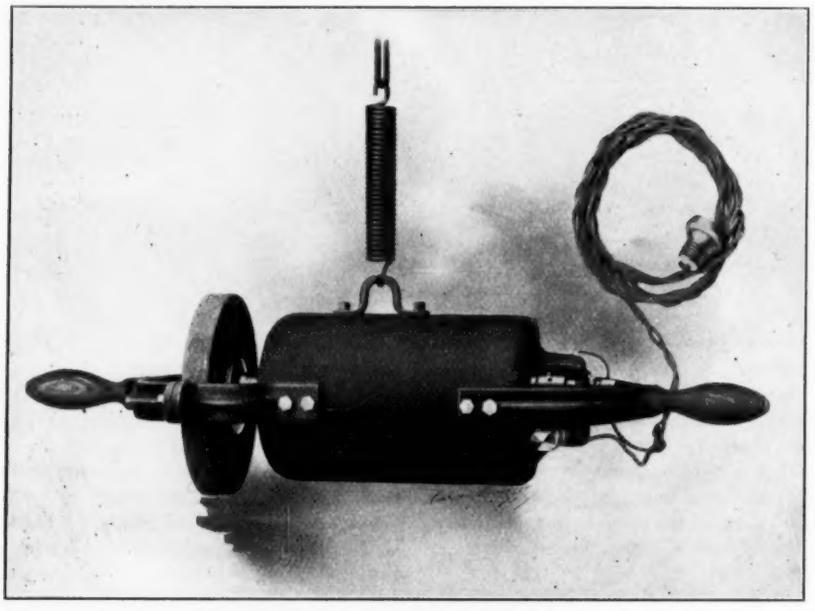


REAR VIEW OF MOTOR-DRIVEN LATHE.

variation are clearly shown. As regularly constructed, the controller is operated from the carriage and not as shown in the front view. The lathe can be furnished, if desired, with a plain pulley in place of the motor, in this case the drive being direct from the line shaft and the spindle still having six speed changes.

ELECTRICALLY DRIVEN PORTABLE GRINDER.

This machine was designed particularly for irregular surface grinding, and the cleaning of castings of any kind or shape. It can be carried to any part of the shop and suspended anywhere, or counterbalanced from the ceiling or a traveler. The motor is enclosed and has adjustable cone bearings; the handles are detachable; the driving power, which must be direct current, is obtained from the ordinary incandescent lamp socket. The machines are made in two sizes of ½ and 1 horse-power



ELECTRICALLY DRIVEN PORTABLE GRINDER.

and weighing 40 and 65 pounds, respectively. They are sent out as illustrated, with cord, socket and wheel. The maker is the Hisey-Wolf Machine Company, Cincinnati, Ohio.

Among the interested visitors to Columbia College during the celebration of the sesquicentennial of its founding was Chas. H. Haswell, who lives not far from the college and was discovered looking about the mechanical engineering laboratory, interested in what he saw, at ninety-five years of age. He stated to the writer that he was still able to shave himself, and looks as tho he might easily reach the age of 100.

Messrs. Van der Linde & Teves, Keizersgracht 382, Amsterdam, Holland, write the *Manufacturers' Record* that they are in want of *hydraulic* tools, such as hammers, drills, chisels, etc., manufactured by American firms.

A Railway Speed Story.

It is always sad to see a nice, artistically gotten up story ripped up the back and its viscera exposed, but the latest effort of the genial Mr. Daniels is thus ruthlessly dealt with by *Engineering News:*

"105 Miles an Hour Record for Central," was the headline which the *New York Times* this week placed over an item regarding a run from Albany to New York over the New York Central & Hudson River Railroad. An examination of the item showed the actual facts to be as follows: The thru mail train from the West left Albany at 1.45 A. M., October 13, 1 hour and 10 minutes late and made the run to New York city, 143 miles, in 142 minutes, or at an average speed a little over 60 miles per hour. The record was taken *to the nearest minute only* of the time of passing each station, and taking these records in connection with the table of mileage between stations, the clever reporter figured out the rate of speed between stations as follows:

"The 4.33 miles between Tivoli and Barrytown was made in exactly 3 minutes, or at the rate of 87 miles an hour. The run from Rhinecliff to Staatsburg, 5.49 miles, was made in 4 minutes, or at the rate of nearly 83 miles an hour; but these performances were eclipsed between Croton and Ossining, when Butterfield, pushing his engine to the limit, made the 3.51 miles in exactly 2 minutes, or at the tremendous rate of 105 miles an hour."

This all sounds very plausible to the newspaper reader and makes fine advertising for the passenger department, but as an actual speed record it of course will not stand examination. If instead of Croton and Ossining we take Peekskill and Tarrytown, the stations next beyond Croton and Ossining, we have by the *Times'* own figures a distance of 16.03 miles run in 15 minutes, or at the rate of 64.12 miles per hour, which is a very different speed from 105 miles.

It may be set down, in fact, that no railway speed record in excess of 75 miles per hour is deserving of credence unless the time is measured to seconds by stopwatches in the hands of careful observers, or the locomotive is equipped, as American locomotives very rarely are, with an automatic speed recorder.

It may be added that all the circumstances point to the improbability of the attainment of any such speed as 105 miles per hour by the train in question over so crooked a road as the Hudson River Division.

One of the highest authenticated speed records ever made was on the Central Railroad of New Jersey on November 18, 1892, when two miles near Fanwood, N. J., were passed over at the rate of 97.3 miles per hour, according to stop-watch measurement. This speed was attained in the middle of a very long tangent and where the engine was aided by a down grade for some distance, circumstances far more favorable to high speed than the conditions under which the New York Central's alleged speed record was made.

The Workman.

This is the work of my hands:
To be but a cog in the wheel—
A strand in the cable that hauls—
To do and to do—not to feel.
To toil till the last curtain falls.
Yet ever the toiler is blest
Who sees the fair vision unroll—
Interprets the dream half-expressed—
Feels the work of his hands with his soul!

This is the work of my hands:
These monsters that furrow the deep
And baffle the power of the sea
Were given the sinews to leap,
Were forged and bolted by me.
These webs of miraculous steel,
Outspun from the shore to the shore,
My nerve and endurance reveal—
I rolled them, and wove them, and bore.

This is the work of my hands:
To drudge, but in spirit be free—
Eat bread by the sweat of my brow.
In accord with the ancient decree—
Yet labor, with courage, endow;
To know that, tho meager the gain,
While justice shows many a flaw—
In spite of distrust and disdain
We are rising, and under the law.

This is the work of my hands:
To cherish the law of the land,
The shield that we've wrung from our foe;
Ennoble the rights we demand,
By the honor and faith we bestow.
For brother am I to all,
The helpless ones and the great;
Together we rise or we fall,
Free workers within a free state.

ROBERT BRIDGES, in *Collier's Weekly.*

Technical Publications.

"Tractive Power Chart." 15x20 inches. The Derry-Collard Company, New York. Price 50 cents.

This diagram or chart is for determining the drawbar pull from the dimensions of a locomotive, or *vice versa.* Its range is from 15x20 to 35x36-inch cylinders, 120 to 230 pounds boiler pressure and 28 to 90-inch driving-wheel diameters. Intersecting curves show at a glance all cylinders and all combinations of boiler pressure and driving-wheel diameters of equal power. The change in tractive power due to a change in cylinder or driving-wheel

diameter and other problems of this class may be solved at a glance. The chart should be of decided usefulness to all who have to do with locomotive design or performance.

"The New York Subway; Its Construction and Equipment." 154 10x13½-inch pages, elaborately illustrated. The Interborough Rapid Transit Company, New York.

This extremely handsome volume has been published to commemorate the completion of New York's great subway system. Very appropriately it opens with an account of the difficulties, physical and legal, which threatened the enterprise with disaster and which New Yorkers are too apt to forget, together with the courage required of those who shouldered the responsibilities of the situation. Following this come clear and beautifully illustrated descriptions of the route and stations, including the various types and methods of construction used, of the power-house and plant, of the system of electrical supply and of the electrical equipment of the cars, of the lighting system, rolling stock, signal and drainage systems, etc. The book is a worthy account of a vast work.

Personal.

Clement M. Street has been appointed commercial engineer of the Westinghouse Electric & Manufacturing Company to handle work in connection with steam railroads. Mr. Street began as a machinist apprentice and then as draftsman with the Buckeye Engine Company and has since had an unusually wide experience with some of the largest engineering concerns. While editor and manager of the *Railway Review*, of Chicago, he made a tour of the world in the inspection of railroads. His latest position was that of manager of the railway department of the Wellman-Seaver-Morgan Company, of Cleveland, Ohio.

Business Items.

The Goldschmidt Thermit Company, New York, has been awarded a grand prize at the St. Louis Exposition.

The Philadelphia Gear Works ran their works all summer with full force and full time, and are quite busy at present filling recent orders.

The Norton Emery Wheel Company, Worcester, Mass., received two grand prizes and two gold medals for its various products exhibited at the St. Louis Exposition.

Roos & Mill have moved into a new and larger factory at 2630-34 Colerain avenue, Cincinnati, Ohio, where they will be able to turn out larger machinery than heretofore.

The S. Obermayer Company, Cincinnati, O., manufacturer foundry facings and foundry supplies, informs us that it has been awarded the highest award and gold medal at the St. Louis Exposition, on plumbago, foundry facings and foundry supplies of all kinds.

The large new shops of the Grand Trunk Railway at Stratford, Ontario, are rapidly nearing completion. Several carloads of machinery have been received from the John Bertram & Sons Company, Ltd., Dundas, Ontario, which firm was awarded the contract for the entire equipment of iron-working tools.

The E. W. Bliss Company, Brooklyn, N. Y., advises us that it has been awarded the grand prize and a gold medal for tools and machines exhibited at the St. Louis Exposition. The awards were granted it for superiority of workmanship, smoothness of action, ingenuity displayed in design and highest quality of product.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., recently had occasion to purchase electric equipment for its works. As manufacturers of starters, controllers and rheostats, the company disposes of its product to most of the manufacturers of electric machinery in the country. Therefore, its position in buying electric machinery was of necessity very delicate, in order that none of its customers might feel offended. After taking propositions from the competing manufacturers of electric apparatus, the company proposed to the bidders to refer the selection of the make to a committee of consulting engineers. It was finally decided to place the matter in the hands of Messrs. Sargent & Lundy, of Chicago, who, after due consideration and deliberation, awarded the order to the Northern Electrical Manufacturing Company, Madison, Wis., as the best type of electrical machinery for industrial plant service. The order consisted of a 75-kilowatt and a 37.5-kilowatt generator.

The increase in mechanical efficiency of engines with forced lubrication has been clearly shown by recent engines built by the B. F. Sturtevant Company, at Hyde Park, Mass., and fitted with a forced pump lubricating system. The company says that an increase of from 8 to 10 per cent. is shown, and with its latest type of vertical single engines a mechanical efficiency averaging 94 per cent. is said to be attained. The increasing demand for mechanical draft continues, not only in the United States but in other countries. The power plant for the new shops of the Mexican Central Railway Company, at Aguascalientes, Mexico, contains a Sturtevant induced draft apparatus consisting of two steel plate fans, each driven by a Sturtevant vertical engine. Each fan is capable of maintaining a draft pressure in the flue connection of each boiler equal to three-quarters of an inch of water when handling all the gases of combustion burning 35,000 pounds of coal per hour with a flue temperature of 600 degrees Fahr. The ring oiling fan bearings next to the fan are water-jacketed to prevent overheating. A counterbalanced sliding damper permits either fan to be cut off from the flues, or both may be operated at the same time. The engines are provided with regulating valves which automatically control the steam pressure.

The Westinghouse Electric & Manufacturing Company received many awards at the St. Louis Exposition for its various products, including a special award in the department of machinery for the best, most complete and most attractive installation; grand prizes for alternating current generators and motors, alternating current turbo-generator installations, static transformers, rotary converters, direct-current generators and motors, electric railway motors, alternating current and direct current and control systems for single and multiple unit operation and for mining and industrial locomotives; gold medals for complete switchboards and controlling apparatus and the application of electric motors for mechanical purposes, alternating current, direct current and Bremer arc lamps and arc lighting systems, electric measuring instruments, industrial betterment work; silver medal for switches, fuses and wiring appliances. The other companies in the associated Westinghouse interests, including the Westinghouse Machine Company, Westinghouse Air Brake Company, American Brake Company, Westinghouse Automatic Air & Steam Coupler Company, Westinghouse Brake Company, Ltd., London; Westinghouse Company, Ltd., St. Petersburg; Union Switch & Signal Company, Cooper Hewitt Electric Company, Nernst Lamp Company, Pittsburg Meter Company, Sawyer-Man Electric Company, Bryant Electric Company, Societe Anonyme Westinghouse, France, and Perkins Electric Switch Manufacturing Company, received a total of nine grand prizes, four gold medals, three silver medals and one bronze medal.

Manufacturers.

The Blairsville (Pa.) City Mills have been burned.

The Stewart Iron Works Company, Covington, Ky., will enlarge the plant.

The Hudson River Woolen Mills, Newburgh, N. Y., are to build an extension.

The shops of the Coal & Coke Railroad at Belington, W. Va., have been burned.

The cotton ginnery and oil mill of the Le Grange (Ga.) Mills have been burned.

The Northwestern Marble Works, Crookston, Minn., will erect a factory in the spring.

The Willis Cultivator Company will erect a building and install machinery at Skipwith, Va.

The Henderson Roller Bearing Company, Toronto, Ont., is to build a factory at Winnipeg, Man.

J. A. McDonald has started a movement to build a tile and brick factory in South St. Joseph, Mo.

The Barber Lumber Company, Boise, Ida., branch of Eau Claire, Wis., will make improvements.

A four-story, 80x175-foot addition will be made to the plant of the Cleveland (O.) Hardware Company.

The wood-working establishment of Joseph Lee, at 46 East Meadow street, East Orange, N. J., has been burned.

Plans have been prepared for a new building at Easton, Pa., for the use of the Easton Brass & Machine Works.

Springer & Lister, machinists and foundrymen, Knoxville, Tenn., are building a new plant in South Knoxville.

It is stated at Rutland, Vt., that the Chittenden Power Company proposes to build a new power-house in Mendon.

A contract has been let to build a three-story addition for the Thompson Iron Works, Philadelphia, Pa., bath boilers.

A three-story, 60x100-foot building is to be erected for the Norton Manufacturing Company, tin cans, Hamilton, Ont.

Excavations for the machine shop of Frank Stutzman, of Williamsport, Pa., at South Fork, Pa., have commenced.

The plant of the Bridgeport (Conn.) Boiler Works Company has been damaged by fire. The concern will rebuild at once.

Ludwig F. D. Schutte, representing the Schencke Piano Company, New York city, has bought some local factory property.

Baxter D. Whitney & Son, manufacturers of wood-working machinery, Winchendon, Mass., are to increase the size of their plant.

The big shops of the Wm. J. Oliver Manufacturing Company, Knoxville, Tenn., are starting full operation. Electricity is used for power.

The foundation for a plant at Straight street and Spring Grove avenue, Cincinnati, O., of E. H. Huenefeld Company, has been completed.

Leander Peck has received a permit to

erect a two-story, 64x103-foot building at Providence, R. I., intended for a jewelry manufacturing plant.

The plant at New Albany, Ind., of the Wood Mosaic Flooring Company, Rochester, N. Y., will be rebuilt, after the fire damage, on a much larger scale.

It is understood that the Timblin Engine & Pump Manufacturing Company, Creighton, Pa., will probably move to Avonmore and increase its capital stock.

The contract has been awarded to build a plant at Simpson, W. Va., for the Maryland Coal Company, of New York city and Lonaconing and Cumberland, Md.

As a sequel to the sale by George A. Gray of his holdings in the Avon Mills of Gastonia, N. C., comes the report that he will build another cotton mill in Gastonia.

A machine shop and foundry are being built at Fenton, Mich., to manufacture the concrete brick or building block machine invented by Ebenezer W. Rider, of Detroit.

The plant of the new Peoria Steel & Tool Company, at East Peoria, Ill., now being built, will be enlarged as a result of the demands for the product that are coming in.

A street railway on the Pennsylvania-Ohio border, promoted by W. H. Walker, of Cleveland, and C. G. Hussey, of Pittsburg, proposes to erect a power-house at Greenville.

The Beacon Manufacturing Company, of New Bedford, Mass., which is to engage in the manufacture of underwear, has asked permission to erect additional buildings at its works.

The Pompton Fuel Developing Company has given contracts for the erection of additional buildings on its plant near Lincoln Park, N. J., the cost of which will exceed $35,000.

Two wagon and wheelbarrow manufacturers from Milwaukee, Wis., have been in Jackson, Miss., prospecting, and the Board of Trade thinks they will establish a big factory there.

The Burlington road's engineering department has plans prepared for the erection of a division repair shop, with lathes, tire setters, etc., and blacksmith shop at Des Moines, Ia.

The American Linen Company has been formed, probably to occupy a big plant at Plantsville, Conn. P. J. Corbett, of New Haven, is understood to be identified with the concern.

The Peerless Motor Car Company, Cleveland, O., intends to put up other new buildings beside the machine shop now under construction. A foundry and erecting shop are proposed.

The Green Foundry & Furnace Works, Des Moines, Ia., have awarded a contract to greatly increase their capacity. The improvements will represent an outlay of about $30,000.

It is stated at New Britain, Conn., that an addition for use as a galvanizing room will be built to the factory in Seymour Park which will be occupied by the Kinnear-Hood Steel Company.

It is reported that the Erie Railroad is planning to electrify the New York suburban service at an eventual expenditure of $30,000,000. A power-house would be built at Paterson, N. J.

It has been rumored for months that a large steel plant will be erected at La Follette, Tenn., and the rumor was practically confirmed recently by Mr. La Follette himself while in Knoxville.

C. E. Williams, proprietor of the Franklin mill, at Franklin, O., will set up a $100,000 flour mill at or near New Orleans, said to be the first in the State of Louisiana, tho this is rather hard to believe.

The Tri-City Regalia Company, of Rock Island, Ill., will incorporate, with a capital stock of $100,000, as the American Regalia Company and will erect a new building in order to enlarge its business.

Hartford City, Ind., hopes to get the Broderick-Quinlan Manufacturing Company, boiler manufacturer, Montpelier, Ind., to locate there. A 120x310-foot building and an electric power plant are proposed.

The Travelers' & Manufacturers' Association, Baltimore, Md., has a communication from the woodwork manufacturing firm of Henry Orewiler, of Cincinnati, O., in respect to building a factory in Baltimore.

There is a project for building an electric power plant at Limekiln Falls, near Oneida, N. Y. J. George Kaelber and Richard Doyle, of Rochester, and Dewitt C. Hadcock, of Oneida, are among those concerned.

W. P. Hammon, the owner of gold dredgers on the Yuba river near Marysville, Cal., has stated his intention to establish in Marysville a machine and repair shop that will give employment to about fifty people.

The Pranker Cotton Mills, Saugus, Mass., which have been idle for ten years, have been sold to a new concern, the Saugus Manufacturing Company, composed of New Bedford capitalists, which will enlarge the plant.

It is stated at San Antonio, Tex., that Messrs. Holmgreen are figuring on making an addition to their plant on Montana street by the first of January. The iron foundry is to be enlarged and a factory for tanks built.

The British Columbia Electric Railway Company, of Victoria and elsewhere, is said to be having incorporated a subsidiary company, the Victoria Power Company, to dam the Koksilah River and develop electric power.

The works on Irving avenue, Burrillville, R. I., formerly operated by the Bridgeton Knife Company, have resumed operations under the name of Mariam Cutlery Company. James P. Kearney is the manager of the new company.

Work has begun on a second factory building at Lansing, Mich., for the Reo Car Company. It will be 50x400 feet. This concern we take to be the new automobile company organized by R. E. Olds, as we noted some time ago.

New Yorkers have visited Baltimore with a view to establishing there a can-making concern, to be called the Continental Can Company, to fight the trust, it is rumored. The name of Edwin Norton is prominently mentioned.

The Reznor Manufacturing Company has had plans prepared for a two-story, 50x150-foot building which it proposes to erect. In this building will be located machinery for making stoves and pipe hooks. The company is located at Mercer, Pa.

The Stephens, Adamson Manufacturing Company, Aurora, Ill., will build an additional machine shop, 120x80 feet, one and a half stories, with cupola. Elevating, conveying and power-transmitting machinery are the products of this concern.

The Delaware Marine Supply Manufacturing Company, Wilmington, Del., is erecting a two-story factory building, 100x40 feet, in which will be fitted an up-to-date polishing and plating plant. This is the first of a series of proposed improvements.

A new lumber and finishing plant will be established in Huntsville, Ala., by James R. Rickey and associates, of Tennessee. He has closed a deal for the site in North Huntsville formerly occupied by the plant of the Lewis Lumber Company, which was burned.

The Yough Brewing Company, Connellsville, Pa., contemplates a gradual rebuilding of its plant. A new outfit of machinery, with the exception of two boilers that are almost new, will be installed. The improvement will include the enlargement of the ice plant.

Ground has been broken at Chattanooga, Tenn., for the plant of the Tennessee Stove Works. Application has been made for a charter by J. L. Caldwell, R. B. Davenport, G. N. Henson, G. W. Corey and J. L. Foust. Employment will be given to 120 men at first.

The John Good Cordage Company has been chartered in New York State with a nominal capitalization of $100,000, and will, it is reported, build a $2,000,000 plant. Mr. Good, who was at one time proprietor of a plant at Ravenswood, L. I., has perfected new machinery.

Gross Bros., proprietors of the Gross Iron Works, foundry and machine shop, of Eugene, Ore., have purchased a lot, 300 feet square, adjoining their plant and will at once begin the construction of a new one. The main building will be about 100 feet square, two stories.

The Piano machine concern at Piano, Ill., which has been occupying the old Henning & Ross building, has let the contract to erect a new factory building 40x70 feet, where it will manufacture its barrel hoop and other machines. The proprietors are C. M. and C. H. Morris.

The American Manufacturing Company is organizing to manufacture "all kinds of new inventions." It is capitalized for $65,000. A factory site is being sought. J. M. Cripe, of Mattoon, Ill., and Chas. H. Asling, of Springfield, Mo., are understood to be among the men interested.

Articles of incorporation of the firm of Charles Mahony & Co., of Schenectady, N. Y., have been filed. It was organized for the manufacture of cotton and woolen goods, etc., and the present offices are at 126 South Center street. It is understood that a factory will be erected.

The Weisenborn Wire Fence Company (capital stock, $10,000) has been incorporated to manufacture a machine for making wire fencing, by George P. A. Weisenborn, of Missouri, and E. C. Chapin and C. K. Chapin, of Lansing, Mich., where it is proposed to establish the factory.

Samuel H. Glidden, of Bridger, Mont., has made a deal by which properties of the Bridger Improvement Company and that of Senator Clark at Bridger are acquired by a Minneapolis and Chicago syndicate. A mill for handling gypsum will be built, to have a capacity of 100 tons a day.

The Acme Flexible Clasp Company, now at Clark and Seventeenth street, Chicago, Ill., has leased the Crosby plant of the American Can Company, on Archer avenue, for a period of ten years. The lessee will make extensive improvements, and is expected to eventually purchase the property.

At Charlotte, N. C., it is stated that James B. Floyd, Thomas B. Floyd, O. B. Nisbet *et al.* have incorporated as the Putnam Mills & Power Company, with capital of $75,000, and will establish a plant at Eatonton, Ga., for developing water-power for manufacturing purposes. Addresses are not given.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Design for 4 to 6 H.-P. vertical gasoline engine. Box 535, AMERICAN MACHINIST.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A practical book, "Dies and Diemaking," post paid $1. J. L. Lucas, Bridgeport, Conn.

Machinists—Table, standard pipe and tapping sizes, 5 cents. E. E. Meyer, Allegheny, Pa.

Steel name and monogram name stamps; diesinking; write for estimates. J. L. Lucas, Bridgeport, Conn.

Automatic machinery designed; working drawings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Write for price on only machine shop, boiler shop and foundry in Black Hills. J. C. O'Donnell, Deadwood, S. D.

Electric motors and apparatus calculated and designed by competent engineer. Room 223, 45 Broadway, N. Y. City.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

Wanted—A second-hand screw machine to take 2 in. stock; must be in first-class condition; state make and price. Box 541, AM. M.

Northern man in South Georgia wants partner to put in foundry in connection with machine shop now running; strictly business. South Georgia Machine Shop, Valdosta, Ga.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

A German mechanical engineer who traveled 2 years in America would like to have an agency for an American firm for Germany. Wm. Steinhorst, 61 Zschochershe str., Leipzig, Plagwitz, Germany.

An old-established English firm of iron and open hearth steel founders, having machine shops, desire to manufacture and assemble machinery or tools for European markets for American makers. Address Wm. Towler, Globe Foundry, Leeds, England.

I want to establish an office in New York, as consulting engineers, with a partner who is now working along somewhat different lines from my own, to share expenses and profits. He should have a wide experience, like myself, and a considerable local acquaintance in his line. Capital is not absolutely necessary, but would lead to larger profits through the handling of larger propositions. I can satisfy the right man as to every detail. Address Box 536, AMER. MACHINIST.

"Spangenberg's Steam and Electrical Engineering." By E. Spangenberg, M. E., former superintendent of the St. Louis School of Engineering. The only book published containing 1,035 questions and answers, with 648 illustrations. A complete reference book for engineers, electricians, firemen, linemen, wiremen, steam fitters and owners of steam, electric and refrigerating plants, etc. Price, $3.50. Geo. A. Zeller, publisher, 75 South Fourth st., St. Louis, Mo. 40-page pamphlet sent free.

For Sale.

For Sale—Back numbers AMERICAN MACHINIST. B. H. Mead, 39 Lenox Place, Hartford, Conn.

For Sale—1 Farrel Foundry hydraulic pump and press; 800 tons; cost $1,950; will sell very reasonable; perfect condition. H. M. Crowell Mfg. Co., 6th ave. and 13th st., Newark, N. J.

For Sale—25 H.-P. standard make stationary gasoline engine, complete with gasoline and cooling tanks, muffler, etc.; used less than three months. Address G. B. F., Box 271, Lansing, Mich.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price, and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

For Sale—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. Irving Fox, Rochester, Minn.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute; 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway, New York city.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Speed and feed boss, or assistant foreman, wishes change; good all-round man; can furnish reference as to character and ability. Box 539, AMERICAN MACHINIST.

Wanted—An office position, by an Eastern man of long experience as a practical and business mechanic; familiar with all details of shop and office; competent to take entire charge of and manage large manufacturing interests and all business connected therewith; is well known in the machine-tool trade and can give ample reference. Address, confidentially, Box 485, AMER. MACHINIST.

ILLINOIS.

Position by foundry foreman; age 34; a good, practical molder; had charge of jobbing foundry the last 4 years; willing to go any place in North American; first-class references. E. J. H., AMERICAN MACHINIST.

INDIANA.

Thorough mechanic, cost reducer, inventive, progressive, broad experience in designing tools and methods for duplicate manufacturing in up-to-date manner, is open for position of responsibility; perfectly willing to demonstrate ability to sound, live firm; toolroom, general foremanship or superintendent. Box 496, AMERICAN MACHINIST.

MAINE.

Pattern shop foreman desires change; long experience at large plant; references given. Address P. F., care AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 523, AMERICAN MACHINIST.

Jig draftsman, shop foreman and automatic machine designer. Box 513, AMER. MACH.

Skilled toolmaker and draftsman, rapid calculator, wants work; have designed some very fast automatics; if you have some new and original machinery to design, let me suggest the way. Address Box 520, AM. M.

Business position or mechanical and civil engineer; young man with technical education, now and for some years head draftsman and designer for high-grade steam engine builders; strict attendance to business; total abstainer from narcotics and alcoholic beverages. Box 526, AMER. MACHINIST.

MICHIGAN.

Expert mechanical draftsman, rapid, accurate, good knowledge of engineering and strength of materials, experienced in machine design, is open for engagement where thorough work is required and where correspondingly liberal salary is paid. Address Box 540, AMERICAN MACHINIST.

NEW JERSEY.

Machine and tool designer wants position; can hold position as general foreman or superintendent. Address Box 481, AM. M.

First-class mechanical draftsman with machine and pattern shop experience, wishes position to design or to work on intricate automatic machinery. I. N. H., Box 537, AMERICAN MACHINIST.

Jones & Lamson flat turret lathe machinist operator, expert, wants situation to operate or take charge. Box 534, AMER. MACH.

NEW YORK.

Up-to-date mechanical superintendent desires change; A1 reputation. Box 517, A. M.

Superintendent, by mechanical expert, familiar with all details of shop management. K. C., care AMERICAN MACHINIST.

Wanted—Position as general foreman or assistant superintendent, by a thorough, practical mechanic. Address M. H., care AM. M.

Experienced graduate mechanical engineer seeks position; shop, field or office; used to handling men; references. Address Box 533, AMERICAN MACHINIST.

Position wanted by capable man; 31; 11 years factory, office, responsible positions; 6 years charge order and stock departments. Box 531, AMERICAN MACHINIST.

Expert, shortly disengaged, wishes to communicate with manufacturer regarding installation of factory costs and systems. "Results," care AMERICAN MACHINIST.

Manager or superintendent; inventor of automatic machinery; technical man, possessing good mechanical and executive ability; practical and up to date in all lines. Box 543, AMERICAN MACHINIST.

Mechanical engineer, graduate of University of Darmstadt, Germany, desires position as draftsman or designer; experience in steam engines, turbines, bridges, locomotives, etc. Box 532, AMERICAN MACHINIST.

Wanted—A position as an operator of automatic screw machines; have handled Brown & Sharpe, Cleveland, Hartford, Spencer and Stehlie machines, or can take charge of hand screw machines or automatics. Address Frank A. Baker, 178 Atkinson st., Rochester, N. Y.

OHIO.

Foundry foreman, with 25 years' experience in foundry business, is open for position; shop of 10 to 25 molders preferred; machinery or jobbing work; will go anywhere. Address M., care AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman, with 3 years' experience on dies and jigs, wishes position in New York or Philadelphia. Box 512, AMER. MACHINIST.

Superintendent's position, on small or medium work of good quality; automobiles or work of similar nature preferred; expert on shop system, cost accounts and management of men. Address Box 538, AMER. MACHINIST.

Skilled general machinist, toolmaker, recent graduated mechanical engineer, extensive experience as draftsman, wants engagement; $1,200 per year. Address 3145 Edgemont st., Philadelphia, Pa.

WEST OF MISSISSIPPI.

Position as electrical engineer or chief draftsman, after December 1; switchboard work preferred. Box 502, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—A strictly first-class man as a working foreman in a small drop forging shop; a man that thoroughly understands the business and can show others how to get out a day's work; references required. Address Box 509, AMERICAN MACHINIST.

Wanted—A thorough practical mechanic as working foreman in a small shop located in a thriving Connecticut city, manufacturing light duplicate machinery; must be able to make jigs, special tools, models and do experimental work; must have inventive and executive ability proven by a successful record; married man, between 35 and 45, preferred; salary in proportion to service; state experience and give references. Address Box 530, AMERICAN MACHINIST.

ILLINOIS.

Wanted—Designer of gas and oil engines, by well-established Chicago manufacturer; must be practical as well as inventive, resourceful and energetic; splendid opportunity for right party; state salary expected. Box 490, AMERICAN MACHINIST.

Wanted—Sale producer with mechanical education and experience; able to handle sales force; good chance for man of brains and energy; advise fully about experience and salary expected; Western location. Box 491, AMERICAN MACHINIST.

Wanted—Civil or mechanical engineer for salesman, familiar with railroad practice, by large railroad supply manufacturer in West; must have good acquaintance and travel; opportunity good for right man; advise fully and salary expected. Box 492, AMER. MACH.

INDIANA.

Wanted—Foreman for assembling department of automobile works; must have served as machine hand and have had practical experience in assembling motor vehicles and in charge of men; salary $20 to $24 per week. Address, with references and full particulars, Box 474, Indianapolis, Ind.

MARYLAND.

Superintendent for small modern plant manufacturing chiefly under own patents;

must be good jig designer, able to redesign parts of machine and to estimate accurately on contracts. "Interchangeable," care A. M.

NEW JERSEY.

Wanted—First-class erecting man for high-speed engine work; competent for outside work. Box 521, AMER. MACHINIST.

Wanted—A first-class metal pattern maker; must be familiar with work on chandeliers and fittings. Box 544, AMER. MACHINIST.

NEW YORK.

Wanted—Up-to-date foundry foreman for about 30 molders; salary $2,000. Address C. R., care AMERICAN MACHINIST.

A superintendent, also sales manager, wanted for old-established, successful manufacturing company; investment $5,000 required but secured to satisfaction. Box 54, AMERICAN MACHINIST.

Wanted—Foreman familiar with machining medium and small cast-iron and brass parts for steam pumps or engines; draftsman experienced on engines and pumps; shop clerk to compile bills of material; give references, experience, age and salary expected. Box 516, AMERICAN MACHINIST.

Jewel worker wanted for making and finishing jewels for high-class scientific and electrical instruments; good position for the right man, competent to select materials and take charge of and do such work. Address, stating experience, references and wages, to Andrew C. Williams, P. O. Box 2000, New York City.

OHIO.

Wanted—Foreman for machine shop; one familiar with well stock and set length pumps. Address C. M. H., care AMER. MACH.

PENNSYLVANIA.

Wanted—Assistant draftsman, by concern building medium heavy machine tools; write, stating age, experience and salary expected. Address Box 525, AMERICAN MACHINIST.

Alphabetical Index to Advertisers.

PAGE

Acme Machinery Co..34 and 166
Adams Co., The.....111
Albro-Clem Elevator Co.....136
Allen, John F.....157
Almond Mfg. Co., T. R.....108
Alteneder & Son, Theo.....148
American Blower Co.....151
American Gas Furnace Co... 20
American Pulley Co.....138
American Tool Works Co.... 8
American Watch Tool Co....112
Armstrong Bros. Tool Co....167
Athol Machine Co.....147
Atkins & Co., E. C.....109
Auburn Ball Bearing Co..... 98
Audel & Co., Theo..... 85
Automatic Machine Co.....133
Automatic Machine Co.....172

Backus Water Motor Co.....144
Badger & Sons Co., E. B....172
Baird & Co., Henry Carey....175
Baird Machinery Co.....177
Baker Brothers.....157
Baldwin & Wight.....147
Ball Bearing Co..... 34
Bantam Mfg. Co..... 29
Barnes Co., B. F..... 87
Barnes Co., W. F. & John... 14
Barnett Co., G. & H...4th Cover
Bartlett, E. E.....136
Bates Machine Co.....148
Baush, W. H.....177
Bay State Stamping Co.....145
Beaman & Smith Co., The...
15 and 130
Becker-Brainard Milling Machine Co..... 13
Beimer Machine Tool Co....131
Bemis & Call Hardware & Tool Co.....126
Bertram & Sons Co., Ltd., John..... 19
Besly & Co., Chas. H.....112
Bethlehem Fdry. & Mch. Co..124
Betts Machine Co..... 6
Bickford & Co., H.....139
Bickford Drill & Tool Co.... 10
Bignall & Keeler Mfg. Co....111
Bilgram, Hugo..... 34
Billings & Spencer Co..4th Cover
Binsse Machine Co..... 34
Blaisdell & Co., P.....112
Blaisdell Machinery Co.....156
Blanchard Mach. Co..... 34
Bliss Co., E. W..... 31
Blount Co., J. G.....140
Boker & Co., Hermann.....150
Boston Gear Works.....136
Bowser & Co., S. F.....138
Boynton & Plummer..... 93
Bradford Machine Tool Co... 5
Brady, James.....177
Brightman Mfg. Co.....150
Bristol Co.....4th Cover
Brown & Co., R. H.....130
Brown & Sharpe Mfg. Co....
79 and 4th Cover
Brown Hoisting Mach. Co...142
Buffalo Forge Co.....4th Cover
Builders Iron Foundry..3d Cover
Bullard Machine Tool Co.... 32
Burr & Son, John T.....172
Burt Mfg. Co..... 18
Butler, A. G.....145
Byram & Co.....146

Caldwell & Son Co., H. W...137
Carborundum Co., The.....102
Card Mfg. Co., S. W..... 22
Carpenter Tap & Die Co., J. M. 24
Case Mfg. Co.....142
C & C Electric Co.....161
Chadwick & Co., G. B.....147
Chambersburg Engr. Co..... 23
Chattanooga Machinery Co...170
Chicago Flexible Shaft Co...114
Chicago Rawhide Mfg. Co....136
Christensen, N. A.....156
Cincinnati Mach. Tool Co....113
Cincinnati Milling Mach. Co... 7
Cincinnati Planer Co..... 18
Cincinnati Screw & Tap Co..150

PAGE

Cincinnati Shaper Co.....178
Clapp Mfg. Co., E. D.....150
Clayton Air Compressor Wks.155
Cleveland Auto. Mach. Co...117
Cleveland Cap Screw Co..... 95
Cleveland Crane & Car Co...142
Cleveland Gear Works.....136
Cleveland Pneumatic Tool Co.156
Cleveland Twist Drill Co....
116 and 4th Cover
Clough, R. M..... 24
Coates Clipper Mfg. Co.....121
Coes Wrench Co.....140
Colburn Machine Tool Co.... 94
Colonial Steel Co.....153
Consolidated Press & Tool Co. 3
Cook Co., Asa S.....130
Crane Co.....145 and 170
Cresson Co., Geo. V..... 93
Crocker-Wheeler Co.....164
Crosby Stm. Gage & Valve Co. 23
Cumberland Steel Co.....150
Curtis & Co. Mfg. Co.....155
Curtis & Curtis Co.....171
Cushman Chuck Co.....130

Dallett Co., Thomas H.....139
Davis Machine Co., W. P....110
Dawson & Gray..... 93
Derry-Collard Co..... 93
Desmond-Stephan Mfg. Co...128
Detrick & Harvey Machine Co. 24
Detroit Lubricator Co.....146
Diamond Drill & Mch. Co....141
Diamond Machine Co...3d Cover
Diamond Saw & Stamping Works.....171
Dickinson, Thos. L.....150
Dill Machine Co., T. C.....108
Dixon Crucible Co., Joseph...145
Dreses Machine Tool Co.....152

Earle Gear & Mach. Co.....136
Eberhardt Bros. Machine Co.136
Electric Controller & Supply Co.....160
Elmes Engr. Works, Chas. F..140
Emmert Mfg. Co.....147
Errington Auto. Tap & Die Co.131
Estep & Dolan.....140
Evans Friction Cone Co.....130
Excelsior Needle Co..... 12

Fairbanks Co..... 92
Falkenau-Sinclair Mach. Co.. 95
Faneuil Watch Tool Co.3d Cover
Farrel Fdry. & Machine Co...123
Fawcus Machine Co.....137
Fay & Scott.....126
Federal Mfg. Co..... 91
Fellows Gear Shaper Co.....173
Felton, Sibley & Co.....170
Fenn-Sadler Machine Co.....141
Fidelity Elec. Co.....162
Firth-Stirling Steel Co.....150
Flather & Co.....126
Foos Gas Engine Co.....144
Foote, Pierson & Co.....165
Fosdick Machine Tool Co.... 15
Foster Co., The Walter H.... 92
Franklin Mfg. Co.....119
Frick Co.....144

Ganschow, Wm.....136
Garden City Fan Co.....171
Garvin Machine Co., The....168
Gay & Ward, Inc..... 83
Gem Mfg. Co.....122
General Electric Co.....158
General Pneumatic Tool Co..156
Geometric Drill Co.....129
Gisholt Machine Co.....106
Gleason Works.....4th Cover
Globe Mach. & Stamping Co.157
Goldschmidt Thermit Co.....142
Goodell Mfg. Co.....170
Goodell-Pratt Co.....100
Gorton Machine Co., Geo....140
Gould & Eberhardt..... 85
Graham Mfg. Co.....147
Grant Gear Works.....136
Grant Mfg. & Machine Co...157
Gray Co., G. A..... 34

PAGE

Gray's Ferry Machine Co....170
Greaves, Klusman & Co.....139
Greenfield Machine Co.....104
Greenwald Co., I. & E.....136

Hammacher, Schlemmer & Co. 91
Hampden Corundum Wheel Co.....130
Hardinge Bros.....127
Harrington, Son & Co., Inc., Edw.....120
Harrison, H. K.....144
Hart Mfg. Co.....170
Hartford Machine Screw Co..107
Hartford Blower Co.....170
Hartford Steam Boiler Insp. & Ins. Co.....144
Heald Machine Co..... 92
Hendey Machine Co..... 89
Heppenstall Forge & Knife Co.170
Herron & Bury Mfg. Co.....156
Hess-Bright Mfg. Co..... 92
Hill, Clarke & Co....87 and 177
Hill, Louis A.....147
Hilles & Jones Co.....177
Hisey-Wolf Machine Co..... 17
Hoefer Mfg. Co..... 23
Hoggson & Pettis Mfg. Co...130
Hollingsworth, Samuel.....170
Holtzer Cabot Elec. Co.....162
Hopkinson Machine Works...175
Horsburgh & Scott Co.4th Cover
Horton & Son Co., E.....130
Houghton & Co., E. F.....123
Howson & Howson.....147
Hubley Mfg. Co.....170
Hunt Co., C. W.....142
Hunt & Co., Robt. W..... 23
Hurlbut-Rogers Machine Co..134
Hyatt Roller Bearing Co....142

Ingersoll Milling Mach. Co...141
Ingersoll-Sergeant Drill Co...155
International Corres. Schools.113
International Power Vehicle Co.....144
International Specialty Co...122
Iroquois Machine Co..... 96

Jacobs Mfg. Co.....130
Jacobson Mach. Mfg. Co....144
Jantz & Leist Electric Co....162
Jeffrey Mfg. Co., The.....177
Jenkins Brothers.....145
Johnson Machine Co., Carlyle.173
Jones & Lamson Machine Co.
26, 27 and 34

Kelly Co., R. A.....121
Kempsmith Mfg. Co..... 16
Kent & Co., Edwin R.....150
Keuffel & Esser Co.....148
King, Hugh E.....156
King Machine Tool Co..... 97
Kinsey-Burt Co.....151
Knecht Bros. Co.....147

Landis Machine Co..... 97
Landis Tool Co..... 81
Lane Mfg. Co.....142
Lang Co., G. R.....171
Leard, Wm. E.....144
Le Blond Machine Tool Co., R. K.....4th Cover
Le Count, Wm. G.....130
Link-Belt Engineering Co....134
Lodge & Shipley Mch. Tool Co. 4
Lombard & Co.....123
Long & Allstatter Co., The...128
Lucas Machine Tool Co.....109
Lufkin Rule Co.....148
Lunkenheimer Co., The.....145

McCabe, J. J.....139 and 176
McCrosky Mfg. Co., F. B..... 24
McGeorge & Sons.....150
Maris Bros.....143
Marshall & Huschart Mch. Co.177
Marston & Co., J. M.....172
Mass. Tool Co..... 98
Massey Machine Co.....150
Meadville Vise.....122
Mechanics Machine Co..... 24

PAGE

Meisel Press & Mfg. Co.....146
Mergenthaler Co., Ott.....127
Merrell Mfg. Co.....142
Merrill Bros.....147
Merritt & Co.....170
Messmer Mfg. Co., Ferd.....136
Mietz, A.....144
Miner & Peck Mfg. Co.....170
Modern Machinery Co.....142
Modern Tool Co.....141
Moline Tool Co.....172
Montgomery & Co.....
139, 140, 145, 146 and 175
Morse Chain Co.....175
Morse Twist Drill & Mach. Co. 33
Morton Mfg. Co.....145
Motch & Merryweather Mchry. Co.....176
Mueller Mach. Tool Co.....137
Mutual Mfg. Co..... 21

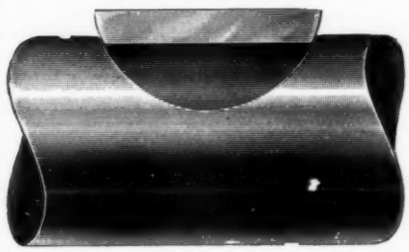
National-Acme Mfg. Co.....178
National Separator & Machine Co.....128
New Britain Machine Co.....124
New Era Gas Engine Co.....144
New Haven Mfg. Co.....110
New Process Raw Hide Co...135
Newton Mach. Tool Wks., Inc. 11
Ney, R. W.....147
Nicholson & Co., W. H.....114
Nicholson File Co..... 17
Niles-Bement-Pond Co.....
176, 179, 180, 181 and 182
Nolte Brass Co.....142
Northampton Emery Wheel Co.....146
Northern Electrical Mfg. Co..161
Northern Engineering Works.142
Norton & Jones Mach. Tool Co.....171
Norton Emery Wheel Co.....105
Norton Grinding Co..... 99
Nuttall Co., R. D.....136

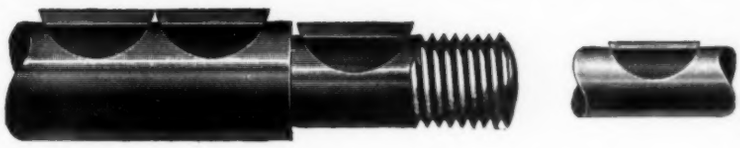
Obermayer Co., S.....146
O. K. Tool Holder Co..... 23
Olds Gasoline Engine Works.144
Oliver Machinery Co.....165
Osgood, J. L.....119
Owen Machine Tool Co..... 28

Parker Co., Chas.....147
Patterson, Gottfried & Hunter, Ltd..... 96
Pawling & Harnischfeger....142
Paxson Co., J. W.....175
Perkins Machine Co..... 30
Philadelphia Bourse.....125
Philadelphia Gear Works....136
Phila. Pneumatic Tool Co...153
Philips Pressed Steel Pulley Works.....111
Phosphor Bronze Smelting Co.146
Pittsburg Blue Print Co.....148
Pond Mach. & Foundry Co., L. W..... 94
Poole Co., J. Morton.....101
Potter & Johnston Mach. Co. 89
Pratt Chuck Co.....131
Pratt & Whitney Co....2 and 3
Prentiss Tool & Supply Co...
169 and 176
Pryibil, P.....172

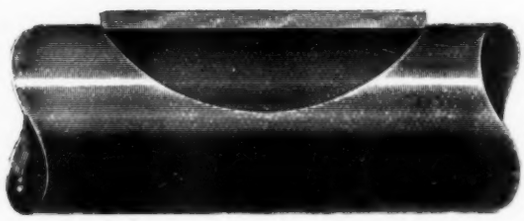
Queen City Machine Tool Co..129

Rand Drill Co.....154
Reece Co., E. F.....170
Reed Mfg. Co.....147
Reeves Pulley Co.....143
Regal Gasoline Engine Co...144
Reliance Machine & Tool Co.126
Remy Electric Co.....144
Rhodes, L. E.....141
Rich, J. & G.....148
Ridgway Dynamo & Engine Co.....163
Rivett-Dock Co.....3d Cover
Robbins & Myers Co., The...162
Robertson Mfg. Co.....175
Rochester Die Shaper Co....172

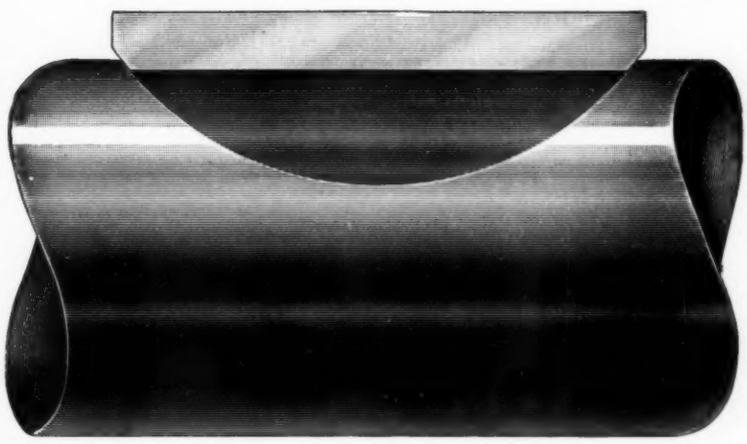




The Woodruff Patent System of Keying



Has been adopted by the Leading Manufacturers of Machinery, Automobiles, etc. There must be some reason for it.



We carry 48 sizes of Keys and Cutters in stock.

Our Hand and Weight (Feed) Milling Machine

Cuts Keyseats Automatically for the Woodruff Patent System of Keying. Many have been surprised at the wide range of work which is being done on this tool.

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C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia.
Fenwick Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal.

THE WHITNEY MFG. COMPANY,

HARTFORD, CONN., U. S. A.

PAGE

Rogers & Hubbard Co.....131
Rogers, Boat, Gage & Drill Works, John M..... 1
Roth Bros. & Co.....161
Royersford Fdry. & Mach. Co.128

Safety Emery Wheel Co.....138
Saunders' Sons, D.....175
Sawyer, Ezra..... 146
Sawyer Gear Works.....136
Schellenbach & Radcliffe..... 21
Schieren & Co., Chas. A..... 98
Schumacher & Boye..... 9
Schwerdtle Stamp Co.....148
Scranton & Co., The.....171
Scranton Whetstone & Abrasive Wheel Co.....162
Sebastian Lathe Co..... 24
Sellers & Co., Inc., William.. 34
Seneca Falls Mfg. Co..... 125 and 157
Shepard Lathe Co.....130
Shultz Belting Co..... 34
Sibley Machine Tool Co.....142
Simonds Mfg. Co.....136
Skinner Chuck Co.....130
Sloan & Chace Mfg. Co.....118
Slocomb Co., J. T.....120
Smith & Mills.....146
Smith Countershaft Co., The.145

PAGE

Smith, E. G.....148
Smith Fdry. Supply Co., J. D.146
Solid Steel Tool & Forge Co.150
Spacke Mach. Co., F. W.....136
Spaulding Print Paper Co....148
Speed Changing Pulley Co...143
Sprague Electric Co.....160
Springfield Machine Tool Co. 97
Standard Connecting Rod Co.144
Standard Engineering Works.141
Standard Gauge Steel Co....127
Standard Pressed Steel Co...142
Standard Roller Bearing Co.138
Standard Tool Co..... 20
Starrett Co., L. S..... 25
Steel Set Diamond Co.....162
Steffey Mfg. Co.....145
Steptoe Shaper Co., John.... 18
Stetson, R. O.....148
Stevens, F. B.....146
Stoever Foundry & Mfg. Co... 24
Stow Mfg. Co.....162
Straley, Hasbrouck & Schloeder..... 147
Struthers-Wells Co.... 144
Stuart's Foundry & Mach. Co. 4th Cover
Sturtevant Co., B. F..... 19
Sutton Co., C. E.....128
Swaine Co., Fred J.....171

PAGE

Sweet, C. F.....175
Syracuse Twist Drill Co.....148

Taylor, Wilson & Co.....137
Three Rivers Tool Co..... 20
Tindel-Morris Co..... 145
Toomey, Frank..... 176
Torrington Mfg. Co.....148
Triumph Electric Co.....161
Trump Brothers Machine Co.130
Tulley & Co., Henry C.....149

Underwood & Co., H. B.....125
Union Drawn Steel Co.....151
Universal Drafting Mach. Co.149

Vanderbeek Tool Works.....175
Vandyck Churchill Co.... ... 16
Vaughn, Turner & Taylor Co. 93
Vitrified Wheel Co.....128

Walker & Co., O. S.....130
Wallace Supply Co.....162
Ward & Sons, Edgar ..T....150
Warner & Swasey Co.....152
Warner Instrument Co.....103
Waterbury Farrel Foundry & Mach. Co..... 29
Watson-Stillman Co.... 124
Wells Bros. Co..... 21

PAGE

Westcott Chuck Co.....130
Western Tool & Mfg. Co.....140
West Haven Mfg. Co..... 125 and 4th Cover
Westinghouse Elec. & Mfg. Co.159
Westmacott Co., J. M.....146
Whitcomb Mfg. Co.....115
Whitman & Barnes Mfg. Co.. 29
Whitney Mfg. Co..... 77
Whiton Mach. Co.. D. E.....132
Wickes Bros..... 96
Wiley & Russell Mfg. Co..... 21
Williams & Co., J. H.....150
Williams, Brown & Earle....148
Williams Tool Co.....170
Wilmarth & Morman Co.....172
Winkley Co..... 141
Woodward & Powell Planer Co..... 96
Woolley Fdry. & Mach. Works.144
Worcester Mach. Screw Co..150
Worcester Polytechnic Institute..... 93
Wormer Machinery Co., C. C.177
Wuichet, Louis.... 165
Wyman & Gordon....4th Cover

Yale & Towne Mfg. Co.....156

Zeh & Hahnemann..... 29

Classified Index of Articles Advertised.

Abrasive Materials
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Scranton Whetstone & Abrasive Wheel Co., Scranton, Pa.
Vitrified Wheel Co., Westfield, Mass.

Arbor Presses
Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings
See Roller Bearings.

Balls, Steel
Federal Mfg. Co., Cleveland, O.

Band Saws, Metal
Greaves, Klusman & Co., Cin., O.
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Oliver Mchy. Co., Grand Rapids, Mich.

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Globe Machine & Stamping Co., Cleveland, O.

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Cleveland Twist Drill Co., Cleveland, O.
Elmes Engr. Wks., Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Houghton & Co., E. F., Phila., Pa.

Belt Filler
Schieren & Co., Chas. A., New York.

Belt Lacing Machine
Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Wickes Bros., New York.

Bending Machines, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
Swaine Co., Fred J., St. Louis, Mo.

Bending Tools, Hand
Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

Blocks, Size
Meisel Press & Mfg. Co., Boston, Mass.

Blowers
American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Hartford Blower Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

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Keuffel & Esser Co., New York.
Pittsburg Blue Print Co., Pittsburg, Pa.
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Williams, Brown & Earle, Philadelphia, Pa.

Blue Print Wringers
Pittsburg Blue Print Co., Pittsburg, Pa.

Boilers
Struthers-Wells Co., Warren, Pa.
Wickes Bros., New York.

Boiler Tube Cleaners
Gem Mfg. Co., Pittsburg, Pa.

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Acme Mchry. Co., Cleveland, O.
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Lang Co., G. R., Cincinnati, O.
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Standard Engineering Works, Ellwood City, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Williams Tool Co., Erie, Pa.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

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Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley Pub. Co., Norman W., New York.
Modern Mchry. Co., Chicago, Ill.
Tulley & Co., Henry C., St. Louis, Mo.

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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Meadville Vise Co., Meadville, Pa.
Motch & Merryweather Co., Cleveland, O.
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Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland Ohio.

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Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
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Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

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Burr & Son, John T., Brooklyn, N. Y.

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Bowser & Co., S. F., Fort Wayne, Ind.

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Armstrong Bros. Tool Co., Chicago, Ill.

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Carborundum
See Grinding Wheels.

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Nolte Brass Co., Springfield, O.
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Franklin Mfg. Co., Syracuse, N. Y.

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Diamond Drill & Mch. Co., Birdsboro, Pa.
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Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

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Curtis & Co. Mfg. Co., St. Louis, Mo.
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Standard Connecting Rod Co., Beaver Falls, Pa.
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Gray's Ferry Mach. Co., Philadelphia, Pa.
Meisel Press & Mfg. Co., Boston, Mass.

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Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

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See Schools, Correspondence.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
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Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
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General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer & Co., S., Cincin., O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

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Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Ct.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Son, John T., Brooklyn, N. Y.
Davis Mach. Co., W. P., Rochester, N .Y.

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Newton Mach. Tool Wks., Philadelphia, Pa.
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Pratt & Whitney Co., Hartford, Conn.
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Osgood, J. L., Buffalo, N. Y.
Steel Set Diamond Co., New York.

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Consolidated Press & Tool Co., Chicago, Ill.
Gem Mfg. Co., Pittsburg, Pa.
Globe Machine & Stamping Co., Cleveland, O.
Perkins Mach. Co., Warren, Mass.
Swaine Co., Fred J., St. Louis, Mo.
Zeh & Hahneman, Newark, N. J.

Dies, Threading, Opening
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Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

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Universal Drafting Mach. Co., Cleveland, O.

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Rich, J. & G., Philadelphia, Pa.
Williams, Brown & Earle, Philadelphia, Pa.

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Keuffel & Esser Co., New York.
Post Co., Fred'k, New York.
Williams, Brown & Earle, Philadelphia, Pa.

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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Mutual Mfg. Co., Bridgeport, Ct.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

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American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Norton & Jones Mach. Co., Plainville, Conn.

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Cleveland Pneu. Tool Co., Cleveland, O.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

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Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck-Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Vanderbeek Tool Wks., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Wiley & Russell Mfg. Co., Greenfield, Mass.

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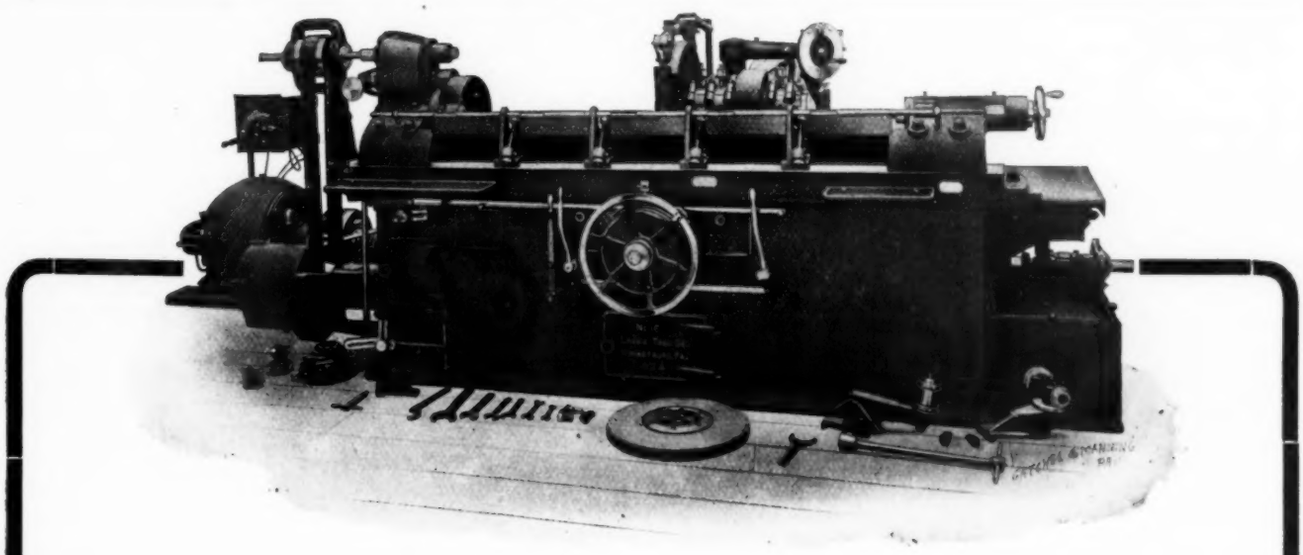
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.



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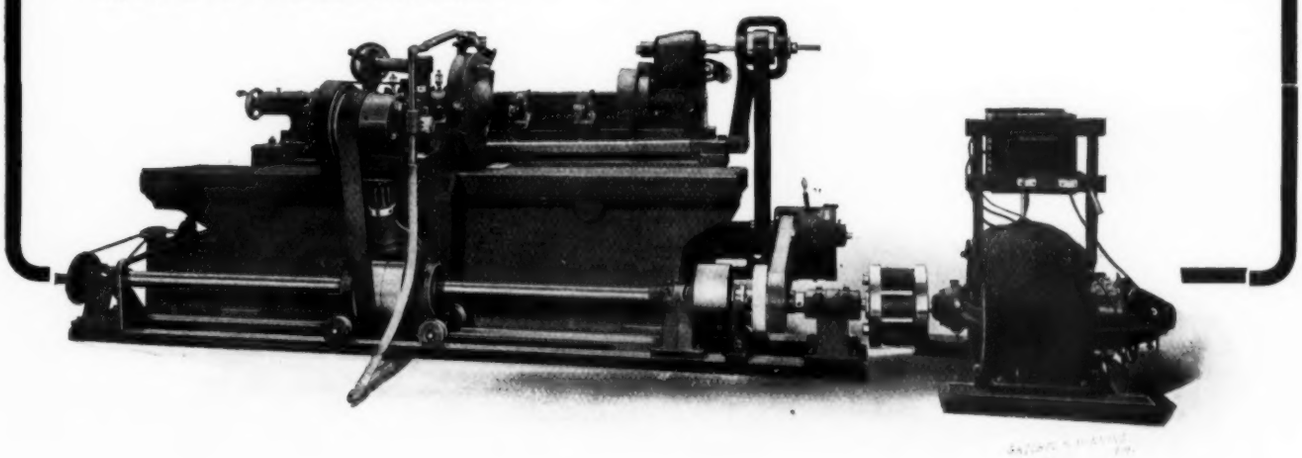

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Olds Gasoline Engine Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
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Struthers-Wells Co., Warren, Pa.
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Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
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Frick Co., Waynesboro, Pa.
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Sturtevant Co., B. F., Hyde Park, Mass.

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Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Nicholson File Co., Provi., R. I.

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Smith Fdry. Supply Co., J. D., Cleveland, O.

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Burt Mfg. Co., Akron, O.
Houghton & Co., E. F., Philadelphia, Pa.

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Badger & Sons Co., E. B., Boston, Mass.

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Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Lang Co., G. R., Cincinnati, O.
Solid Steel Tool & Forge Co., Pittsburg, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Electric
King, Hugh E., Chicago, Ill.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Meisel Press & Mfg. Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Gear Works, Cleve., O.
Cresson Co., Geo. V., Phila., Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Meisel Press & Mfg. Co., Boston, Mass.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Rawhide
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer & Co., S., Cincin., O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R.I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ney, R. W., Pine Plains, N. Y.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Foster Co., Walter H., New York.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.

Molding a Flywheel With Wrought-Iron Spokes

BY R. H. PALMER.

The casting to be made is shown in Fig. 1. It is about 8 feet in diameter and weighs 5,000 pounds.

The spindle seat *A*, Fig. 2, is bedded in the floor some 8 to 12 inches below the floor level, as it is kept there permanently to be used for different work as it comes along. Spindle *B* is placed and the finger is dropped on, resting on collar *D* which is fastened by a set-screw. A strike is bolted on to the finger and the bed is struck off with a depression *X* in the center. The strike and collar are then removed and a core which is to form the bottom of the hub is slipped down on the spindle and placed as shown at *X*, Fig. 2. The core with its companion core spoken of later is shown inverted at Fig. 4. Care is taken to center the inside of this core by the spindle and also to see that it is level. The print for the center core which is to set into this does not extend all the way thru.

The collar *D* is raised and held by the set-screw, and the finger *E*, with strike *F* bolted to it, is slid down on the spindle and rests on collar *D*. The finger *E* is split from the spindle outward, so that it may pinch the spindle and be rigid as to position when the bolt at *H* is tightened.

A line is marked with the blade of strike *F* at the proper distance from the center for cores *J* to set. These cores are to form the inside of the wheel rim. They are then laid to this mark and trued by strike *F*. As the spokes are to be of wrought iron staggered, one-half of the spokes are laid in the cores, as shown at *K K*, Figs. 2 and 5.

The strike is now removed and the core *B*, Fig. 4, is stepped down over the spindle and rests on the core forming the lower part of the hub (see *A*, Fig. 3) resting on *O*, Fig. 3. A second core *B*, Fig. 3, like it, is reversed and slipped down and rests upon it. These cores also are centered from the spindle.

The second half of the iron arms *C C*, Fig. 3, are now laid in position. The strike *F* is replaced and rim cores *E* are placed and trued into position by strike *F*. The cores forming the inside of the rim are now clamped together by clamps *H* and the clamps tightened by wedges. Gate-sticks *X*, Fig. 3, are set to match the gates and sand is carefully tucked inside the cores.

The strike is now removed and the curb or cheek *X*, Figs. 5 and 6, which is to form the outside, is placed in position. A section of the rim *I*, Fig. 5, having its outside face the same radius as that of the wheel wanted, but of less thickness than the wheel rim will be, is now used but held away from the cores to give the right thickness by pieces *M*. In this way the face or rim of the wheel can be made heavier or lighter, as desired. The inside and the outside are rammed up together and the outside is struck off level with the cores as at *A*, Fig. 6, and vented. The pieces *M* are then drawn up, the segment is moved along, and so on until all the way around. Before the segment is moved, a coarse vent wire is used to form a line of vents within 1¼ inches or so of the face of the segment; the wire is also run down on the inside at the back of the cores, and the vents near the face of the segment are scratched out to the curbing. Covering cores *N* Fig. 5, are now laid on, their edges resting on the sand outside and on the cores inside. Cinders are placed be-

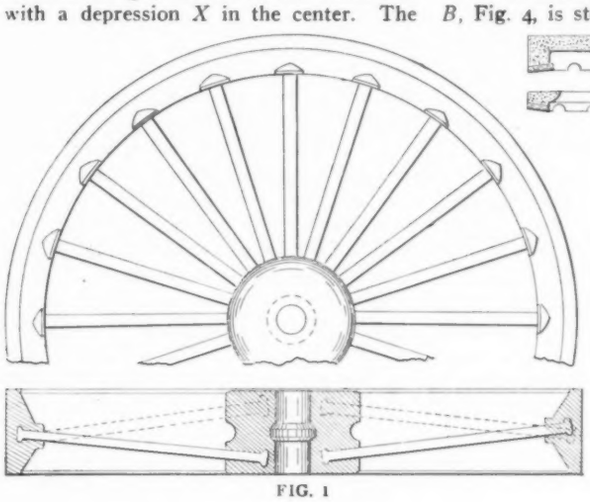


FIG. 1

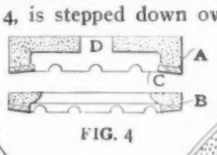


FIG. 4

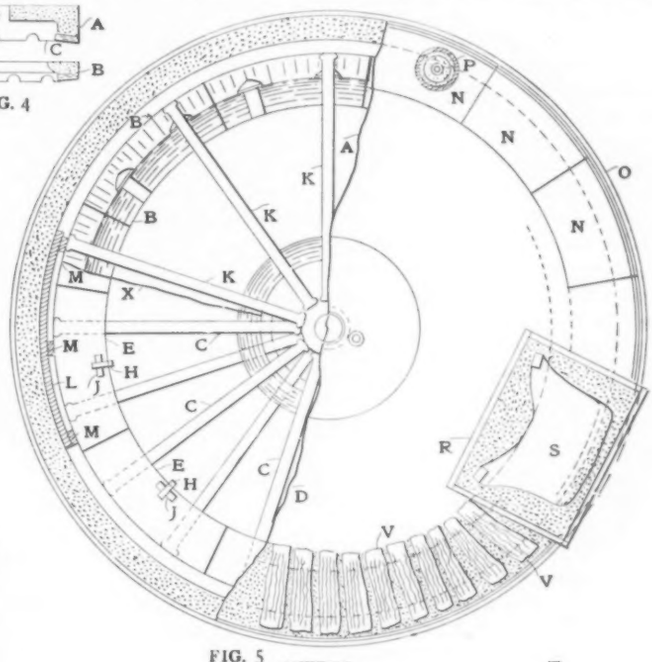


FIG. 5

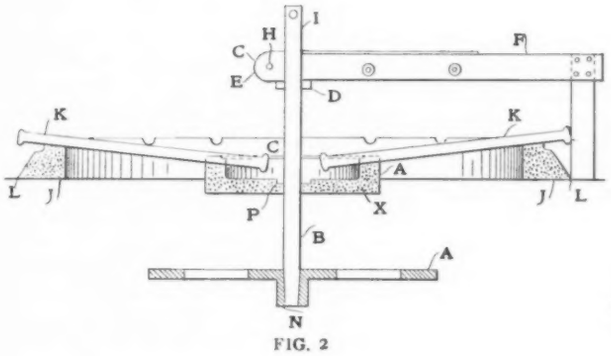


FIG. 2

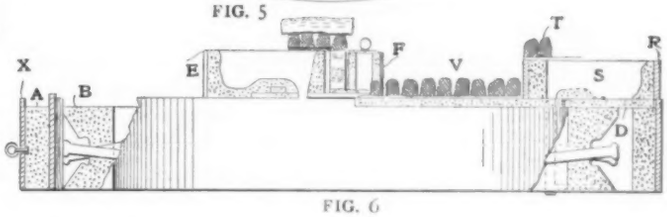


FIG. 6

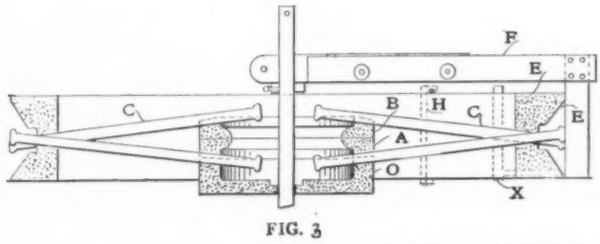


FIG. 3

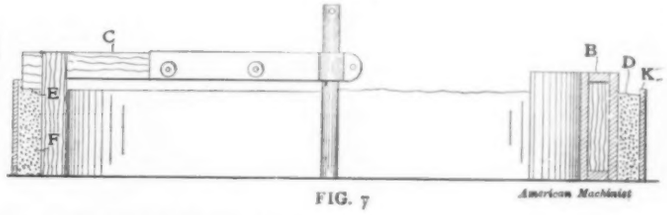


FIG. 7

MOLDING A FLYWHEEL WITH WROUGHT-IRON SPOKES.

tween the curbing and the covering cores, as at *O*, Fig. 5, riser boxes *P* are placed and a very large gatestick, tapered down to some 1½ inches in diameter where it joins the casting is used, and risers are built in two places opposite each other thru which the rim is to be churned. As these rims weigh some 4,000 pounds, they "live" and have to be fed for some time, but one head always sets up some little time before the other. Clay balls are laid over or in the openings which are to be the flow-offs. The joints between the cores are either stopped in with soft clay, or old newspapers are laid over the cores and cinders, on top of which loose molding sand is shoveled. The runner box *R* is placed and runner *S* is built. Pig iron is now laid over the covering cores *V*, sand is tucked around it and some pieces are laid across the runner box as at *T*, Fig. 6. An old pulley rim is laid around the hub cores and sand is tucked around the outside. This is done so that there may be no chance for the iron to flow into the hub by accident, and openings are made down to the cinders around the covering cores so that the vent may readily escape. The risers are kept covered while pouring.

The rim is poured one day, and the hub the next, so that the rim may have plenty of time to shrink.

When the spindle is removed, oily cotton waste is used to fill the spindle seat, this being easy to remove at any time, and keeping the seat in good condition. Sand is filled over it up to the core-print *P*, Fig. 2. The center core is now set, and core *A*, Fig. 4, is closed over it. Imagine core *A*, Fig. 4, closed down on top of *B*, Fig. 3, with the center core sticking up into print *D*. In this core are openings for the pouring gate and the riser for churning.

The core being in place, the runner box *E*, Fig. 6, is placed with a strip of iron under it, and the runner is built, also the riser box *F*, Fig. 6.

Enough pig iron is piled on to the bar and core to hold it down. As the wheel is some 8 feet in diameter, the shrink is very near an inch, but I find that in such a body of iron the shrinkage is not quite what we would term full, or ⅛ inch to the foot, but this depends on how a man mixes the iron.

In order to have the gray iron properly take hold of the wrought iron, the spokes before setting are given a coating of silicate of soda or liquid glass, which is allowed to harden and the molten metal then lies very peaceably to the wrought-iron spokes.

Fig. 7 shows a partly different way of molding the same wheel. The cheek is here first swept up and then hoisted and swung off to one side. In this way a nicer looking wheel can be made, as a good chance is given to finish and black the cheek, and also the center is a little more quickly formed, but of course much more room is required in the foundry.

Alcohol for Motors—IV.

BY M. C. KRARUP.

Some consideration of the causes for the high thermic efficiency obtained with alcohol as well as of the difficulties which have already been partly or entirely overcome in its use will show the situation, and its promise for the future, more clearly.

High compression and complete combustion furnish almost the entire explanation. Long stroke, while necessary for the highest efficiency in somewhat greater degree than for gasoline, but probably not as much as for kerosene, forms (together with its concomitant feature, low number of revolutions per minute), a factor whose importance depends greatly upon the degree of compression and the composition and temperature of the explosive mixture when fired, these being the principal elements influencing the rapidity of flame propagation with any given fuel. This being the case, the data for determining the best length of stroke are, as yet, too much complicated with other factors to permit establishing a practical comparison with gasoline on this point. The tendency among designers is distinctly to let high compression take care of this matter, so as to have as little difference as possible in the main dimensions of alcohol and gasoline motors.

A rather important question arises in connection herewith. It has been commonly believed that the combustion of alcohol vapor (and of kerosene vapor also) was much slower than that of gasoline, the relations being supposed to be parallel with those between prismatic slow-burning powder and fine-grained gunpowder. Under this supposition we should expect rapid ignition of the whole mass of alcohol mixture followed by a relatively prolonged combustion, rendering a long stroke as much of a requirement for efficiency as is a long bore for heavy cannon. What we know is, however, only that ignition plus combustion requires more time than with gasoline, under equality of compression, temperature and ignition method, and if the delay is due to slow flame propagation and may be overcome by higher compression and other available means, it is not excluded that nearly "square" design—stroke equal to piston diameter—may be almost as well adapted for alcohol as for gasoline, in neither case giving full efficiency but desirable for other reasons, especially in automobiles. A glance at the indicator card of a highly efficient alcohol explosion, Fig. 1 (according to Prof. Wender), would seem to support this theory, the sudden drop from highest pressure presenting small probability of a sustained combustion, while the slight departure from the perpendicular of the explosion line indicates that the ignition was not instantaneous, spite of the very high compression of 10¼ atmospheres.

In the gasoline motor compression is strictly limited by the danger of premature ignition, seldom exceeding 75 pounds per square inch, while the low inflammability of alcohol emphasized by the presence of water in this fuel makes it possible to obtain an explosion pressure of 43 atmospheres by increasing the compression to nearly twice the maximum used for gasoline. But the same properties of hydrated alcohol also mean that the conditions for ignition are more exacting than for gasoline, this resulting in difficulties when it is desired to start a cold motor with this fuel.

In all the German alcohol motors benzine or gasoline is used for starting, the carburettor or spray device having a double float chamber, one of which contains the more inflammable and volatile liquid (the boiling points of raw benzine and 90-degree alcohol are about the same, however, both close to 80 degrees Cent. [176 degrees Fahr.]), and by the simple switching of a lever the suction stroke is made to take effect from one or the other liquid.

Compared with gasoline, alcohol requires 2½ times as much heat to effect vaporization and the water in it requires 5 times as much per weight unit, according to Professor Meyer. The heat must either be more intense or be sustained longer. The latter is preferable in order to obtain a homogeneous mixture, but not so practicable. Sorel has determined the relations for the French fuels, stating that 1 kilogram of 90-degree denatured (methylated) alcohol absorbs 288 calories in its evaporation; carburetted alcohol (half benzol) 196 calories, and benzine 120 calories. Remembering that the volume of air required in the mixture is much smaller in proportion to the volume of alcohol vapor to be generated by it and mixed with it than with gasoline, we are not astonished to find from the records of experiments by Sorel that, if condensation is to be avoided, the mixture must at no time be below 26 degrees Cent. [78.8 degrees Fahr.] with the minimum amount of air, while it may go down to 22 degrees Cent. [71.6 Fahr.] if 1.3 times the minimum of air is used, and to 17 degrees Cent. [62.6 degrees Fahr.] if 1.7 times the minimum of air is used. This of course has strong bearing upon the start of the motor with alcohol in cold weather and also upon subsequent operation, and accordingly we find in descriptions of carburettors that provisions are made for heating at both air intakes and that the neutral air intake is little used and in some carburettors is even absent, all the air possible being needed for evaporative effect. Operating in an atmosphere fully charged with humidity at 15 degrees Cent. [59 degrees Fahr.] Meyer finds that a temperature of 190 degrees Cent. [374 degrees Fahr.] is required to prevent suspension of liquid fuel in the mixture, but with excess of air he, too, finds that the need of high temperature decreases, so that 125 degrees Centigrade [257 degrees Fahr.], for example, was sufficient to carry the

vapor in that motor in the Berlin trials, which showed the greatest efficiency with the poorest mixture. In general, the best effect was obtained from a cool mixture heated by high comparison—just as with gasoline motors. These facts explain the remark made earlier in this article: that with alcohol high compression is not only the great advantage which produces high caloric efficiency, but it is also a necessity.

The conditions for successful operation which relate to temperature are narrower than with gasoline, but when complied with, the combustion is much more perfect.

This somewhat delicate equilibrium of temperature which must be maintained in order to get the full benefit of the fuel's possibilities is instanced by Fehrmann, who showed that twice as much alcohol was required to drive a motor (on half load) when the cooling water was kept at 15 degrees Cent. [59 degrees Fahr.] as when the cooling water was 100 degrees Cent. [212 degrees Fahr.].

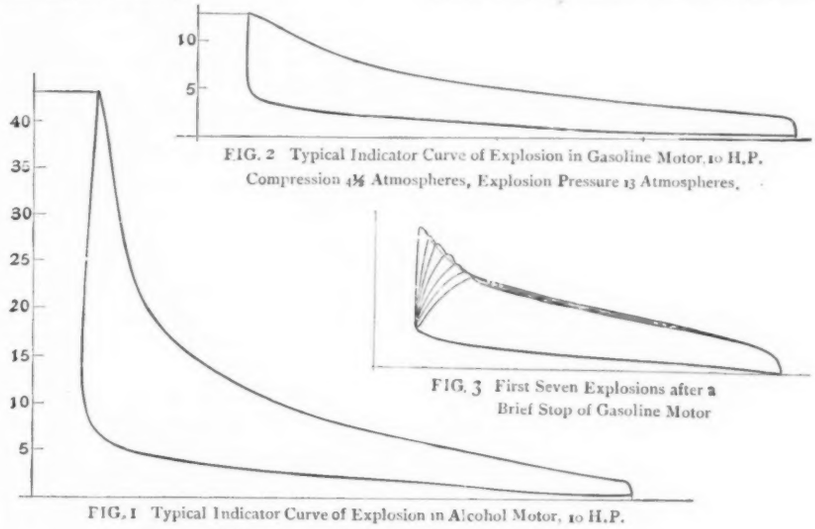


FIG. 2 Typical Indicator Curve of Explosion in Gasoline Motor, 10 H.P. Compression 4½ Atmospheres, Explosion Pressure 13 Atmospheres.

FIG. 3 First Seven Explosions after a Brief Stop of Gasoline Motor

FIG. 1 Typical Indicator Curve of Explosion in Alcohol Motor, 10 H.P. Compression 10½ Atmospheres, Explosion Pressure 43 Atmospheres.

American Machinist

It has also been shown that the best cooling system for fuel economy with a large stationary alcohol motor consists in connecting the jacket or surrounding the cylinder with an open tank, without any forced circulation, but in which the water is kept between a low and a high level by periodical additions of water of about 100 degrees Cent. [212 degrees Fahr.].

When hit-and-miss governing is employed, there is a notable falling off in the strength of explosions after each cut-out, owing to the cooling of the cylinder walls in the interim. The effect is shown graphically by Schöttler in *Die Gasmaschine*, page 329, for a gasoline engine, and is said to be more pronounced with alcohol. The card, reproduced in Fig. 3, shows seven successive explosions after a cut-out, superimposed. In the first one the inflammation is distinctly slow, and not till the seventh is there return to the full capacity of the engine.

With all of this sensitiveness to temperature it should not be forgotten that the Deutz engine with spray injection, at middle of suction stroke, is highly efficient, and Capt. C. C. Longridge, in his contributions to the subject in *The Engineer*, of London, expresses the belief, from his analysis of the records, that the alcohol engine will eventually be operated without recourse to gasoline for starting, or heating of a carburettor by exhaust gases, jacket water or lamp, by the injection of superfinely atomized alcohol near the end of the compression stroke, relying solely on the compression for producing the necessary heat.

During the first few years when alcohol motors were tried, valves and valve seats were frequently found affected by rust, and soot deposits in the combustion chamber were also observed. Acetic acid ($C_2H_4O_2$) was found in the exhaust, indicating the cause of the rust. The difficulty was—as that still experienced with kerosene—due to splitting of the radicals into new combinations under the effect of too great heat in the vaporization methods, or not enough heat causing the suspension of occluded water in the mixture, which led to the formation of formic aldehyde (CH_2O), and again to acetic acid by the resulting incompleteness of the combustion. These effects were strongly noticed at the French trials of 1901, and are still frequently mentioned in the way of a serious objection to the employment of alcohol as a motor fuel. In the 1902 French trials they were, however, very little noticed, having been largely overcome by the use of improved carburettors vaporizing the alcohol, and the water in it, thoroughly before introducing the mixture in the cylinder. For slow speed stationary motors operated under full load and test conditions such complete prevaporization gives the most complete combustion and highest efficiency, according to both French and German tests, but for all other conditions, especially for automobile and other high-speed motors, results in practise seem to support the idea that where the extremely short time available for vaporization involves the risk of carrying the water in the alcohol in a liquid form mixed with completely vaporized alcohol, it is preferable to postpone the vaporization of the whole mass by injecting it as a finely atomized spray and relying solely upon the heat of the cylinder walls and the compression to effect the vaporization. As with kerosene, the less time elapses between the fuel's transformation from a cold liquid to a gas mixed with air and its combustion, the better is the guarantee against the formation of incombustible compounds.

The French automobile and technical press, while accepting the demonstrated fact that neither rust nor soot is to be feared under ideal operation, gives frequent expression to complaints of rust forming under other conditions and of the need of special care for avoiding it (by wiping the exposed parts) and also occasionally mentions the formation of carbonaceous deposits as still occurring in automobile practise. The explanation that these cases may be traced to "poor carburettors" is not readily accepted, but it is admitted that they may be mainly due to the 8.55 per cent. of methylic alcohol in the French fuel (or half of this percentage in the benzol-alcohol). Before the Alcohol Congress of 1903, in Paris, Mr. Baillet, while laying before it a detailed plan for local alcohol expositions and demonstrations which may be of interest here when the time shall be ripe, urged the need of adopting a different denaturant from wood spirits, in order to avoid formic aldehyde. On the other hand, Mr. Sorel, before the same congress, warned against the assumption that whatever remained of the evil must necessarily be due to the methyl alcohol, stating that, under complete guarantees of having no aldehyde in either the fuel or the air, aldehyde had nevertheless been known to form in the mixture at a temperature of 250 degrees Cent. [482 degrees Fahr.], which may be considered a normal temperature under high compression. The inference from this and other facts previously referred to (especially in regard to the high efficiency from *cool* mixture and high compression) would seem to be that the aldehyde is most likely to form from a vaporized mixture drawn in at too high temperature, and that it is best avoided by a cold spray injection of the fuel followed as closely as possible by compression and ignition. This is not M. Sorel's inference, however. He draws none in this instance, but in general believes in pre-vaporization, just as most of the theorists do with regard to kerosene, tho all the progress applying to *working conditions* comes by the other method, with both fuels, even if the Diesel motor is left out of consideration.

In Germany little is heard of rust or soot formation, the motors operated with alcohol being nearly all stationary or slow-

traction engines (as may be seen from the list given below), in which the proper conditions for forming and igniting the explosive mixture are approximately observed, besides that the denaturant is benzol instead of wood spirits. The Institute for Experimental Fermentation in Berlin exhibits motors which have been run for several years without sign of rust or deposit, excepting that one small motor which has frequently been operated idle or under light load shows some soot.

Summing up, the rust and soot trouble seems, then, to resolve itself into this—that methyl alcohol is a doubtful denaturant, and that, moreover, the trouble is well worth watching in all motors, and especially high-speed motors, operated with highly varying power requirements and in which the governing and throttling systems involve many and sudden variations in the thermic conditions. This would apply strongly to automobile motors in which throttling means reduced compression (as it now practically does in all of them, whether the inlet valve is mechanically operated or opened by suction). Ignition at low compression means slow inflammation of a mixture probably insufficiently vaporized, and this is of all things what is to be most avoided with alcohol.

In the very nature of alcohol there seems, however, to be a remedy, which should at the same time obviate the danger of rust and soot and increase the motor's efficiency (reduce the fuel consumption) under the light loads which are the normal loads in automobile practise. I refer to the wide range of air admixture (from 10 to 25 volumes of air for 1 of vapor) under which alcohol vapor retains its complete combustibility. It should be easily possible to devise a throttling arrangement based on a scale of reduced vapor admissions synchronized with a scale of increasing air admissions; but, so far as I can find, it has not been done as yet. Nevertheless, the perfect adaptation of alcohol to automobile requirements would seem to depend on such an arrangement, substituting variable composition entirely for variable compression and constant composition.

As to the question whether alcohol under these circumstances can prove equal or superior to gasoline for automobile motors, there can be little doubt that it is mechanically a much simpler problem to maintain a constant total volume than a constant composition of a gaseous mixture, as also evidenced by the very general failure to obtain complete combustion from automobile gasoline motors—a failure which is not punished by rust formation, but in many minor ways equally objectionable in the aggregate.

One of the most promising features of the alcohol motor for automobile purposes is undoubtedly the very effective internal cooling caused by the absorption of heat in converting the water in the alcohol into superheated steam, a process which serves the transmutation of heat into work doubly: adding directly to the power by the steam expansion and obviating the excessive waste now taking place thru the necessity of energetic external cooling by forced circulation of water. It is only thru such an expedient that we may expect to escape the very considerable incumbrance of the automobile which the external cooling system involves, while saving the metal of the motor in some measure against the deteriorating effects of rapidly successive expansions and contractions, and improving the lubrication. The process is distinctly the most practical one in line with the efforts that have been made for combining the steam and the explosion engine. The rest, I believe, have got no farther than out of the Patent Office. And the simplicity of this process depends upon that quality of alcohol that it is miscible with water, while kerosene and gasoline will not absorb water, and at low temperature —for some mixtures even above the Centigrade zero—will expel an alcohol admixture if left at perfect rest, as in the reservoir of a lamp.

Some names and figures from the German alcohol movement will indicate the importance attached to the employment of this fuel for motor purposes in that country. Russia, where the sale of alcohol is a government monopoly, shows a similar activity, being particularly progressive in developing its use in marine motors, small and large. The Russian denaturant is for the present 5 per cent. methyl alcohol and ¼ per cent. animalic oil, but the government offers a prize of 50,000 rubels for the discovery of a better denaturant, in which the fiscal and technical requirements shall be suitably combined. A study of the Russian movement in its details would probably be of especial interest in America, as the two countries have so many conditions in common, such as a large petroleum production and abundance of low-priced land where cereals may be produced cheaply, but the facts are not at hand, and it seems that at present the alcohol motors used in Russia are made in Germany.

At the Berlin exhibition in 1902 the following manufacturers of alcohol motors were represented:

Dürr Motoren-Gesellschaft, m. b. H., Berlin, SW.

Dresdener Gasmotoren-Fabrik, vorm. Moritz Hill, Dresden, A.

Gasmotoren-Fabrik Deutz, Köln-Deutz.

Theodor Kaulen, Berlin, C.

Gebrüder Körting, Körtingsdorf b. Hannover.

Kühlstein Wagenbau, Charlottenburg.

Th. Lehmbeck, Halensee b. Berlin.

Motorfahrzeug und Motoren-Fabrik, Marienfelde b. Berlin.

Motoren-Fabrik Oberursel, Oberursel b. Frankfurt a. M.

Automobil und Motoren-Fabrik Fritz Scheibler, Aachen.

Maschinenbau Actien-Gesellschaft, vorm. Ph. Swiderski, Leipzig-Plagewitz.

Motoren-Fabrik Werdau, Werdau.

I now see a number of other names n entioned, here and there, of other manufacturers who have joined the movement later, but omit them as the list would not be complete. The above names and addresses may serve the convenience, however, of those desirous of further investigation. The Centrale fur Spiritus Verwertung, Berlin, can no doubt give the complete list.

This organization up to January, 1903, had contracts to supply 770 users of alcohol motors with fuel, and in January, February, March and April furnished them 800,000 liters (211,000 gallons) for such use.

What this means is perhaps best illustrated by the estimate, by Prof. N. Wender, that a 10 horse-power locomobil (threshing machine) consumes 14,000 liters (3,700 gallons) alcohol in 300 workdays of ten hours each; an outlay for fuel of about $535 for the year, at the German price of 15 pfennigs per liter. A somewhat higher estimate allows 50 kilograms alcohol (about 60 liters or 15 gallons) for ten hours' work, and contrasts this with the requirement of 400 to 500 kilograms coal if a steam engine is used. The difference in the cost of hauling the fuel from place to place, as well as in convenience and readiness for work, is of course largely in favor of alcohol.

From a semi-annual statement made July 31, 1903, by the *Centrale* we see that the number of motors operated with alcohol (distinguishing from the number of users in the above) was 1,011, averaging 7.6 horse-power each. Of these 436 were portable work engines, 526 stationary and only 49 were employed in automobiles and boats. More in detail the list was as follows:

Agriculture	544
Pumps	84
Dairies	63
Generating electric light	52
Bakers and butchers	33
Brickyards	15
Machine tools and printing shops	29
Woodwork	45
Breweries	18
Grist mills	40
Building operations (hoisting, etc.)	14
Demonstrations and advertising	15
Boats	20
Automobiles	30
Locomotives	9

The consumption for alcohol lamps and alcohol heaters and cooking stoves greatly exceeded the consumption for motor purposes, but a brief review of the situation in regard to these uses of the fuel and also some consideration of the tax-free cost of production of ethyl alcohol in this country and other commercial factors, must be the subject for another article.

Boring, Facing and Milling Machine for Small Compound Cylinders.

BY DR. ALFRED GRADENWITZ.

The machine represented herewith is being constructed by the Elsässische Maschinenbaugesellschaft, of Grafenstaden, Alsatia. It is a combination of a boring and a milling machine, which are also constructed apart.

The combined machine serves for the simultaneous boring of a cylinder, the facing of its flanges and the milling of any portion to be finished on one side.

After boring the first cylinder the head- and footstock are moved transversely with respect to the milling frame in order to be brought in position for boring the second cylinder.

The boring spindle is driven by a four-step pulley and worm-wheel, either directly or thru double wheel gearing readily thrown into or out of action. The long boring spindle is well guided in the hollow main spindle and has an automatic variable feed thru a rack and gearing.

After disconnecting the automatic feed, the boring spindle is moved to and fro by a hand-wheel or else drawn back rapidly by means of the rack pinion.

The boring spindle has at its end a taper hole and slot for receiving boring bars, drills, etc. The table for the work, as well as the foot-plate, are adjustable longitudinally. Both the main spindle head and collar spindle are fitted with facing arms, to allow the cylinder ends to be faced simultaneously, the tools having an automatic feed by means of a star wheel.

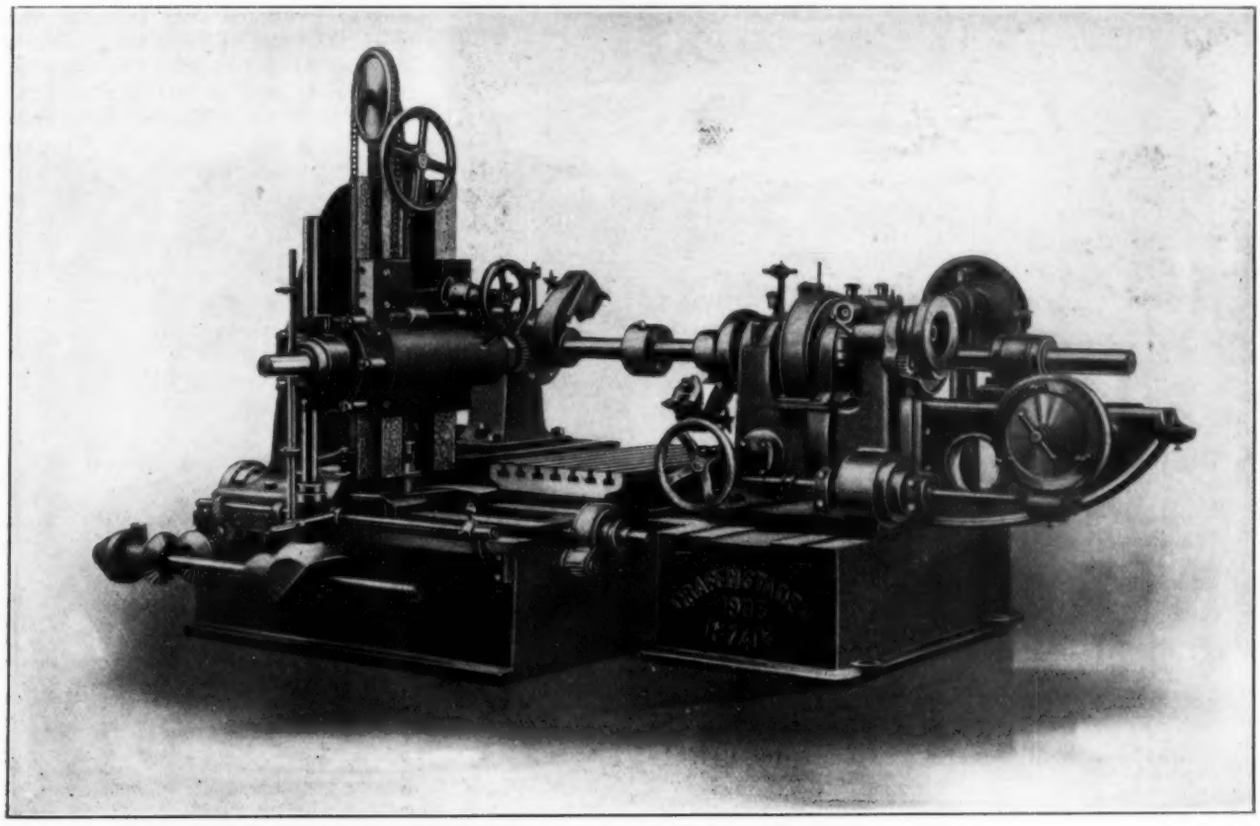
By removing the work plate, cylinders of larger diameter may be bored, these being clamped directly on the bed of the machine.

The upright of the miller moves on a bed rigidly connected to that of the drilling machine, and supports the vertically adjustable saddle, which is balanced by counterweights and in which the milling spindle has longitudinal movement.

The milling spindle is driven by a four-step pulley, beveled and worm gearing, either directly or thru intermediate gearing. The miller is adjusted laterally by hand with the aid of a screw and hand-wheel.

The self-feed of the column and spindle carriage is effected by a step pulley and gearing, giving six variations of feed. It may be thrown out at any desired point automatically by adjustable stops, or by hand.

Berlin, Germany.



CYLINDER BORING, FACING AND MILLING MACHINE.

Aluminum Iron Molds for Brass Castings.

We noted last year, at page 1781, Vol. 26, that a patent had been granted to F. J. Friese and J. E. Gilbert, of St. Louis, for the process of coating with aluminum paint the surfaces of iron molds when used for brass castings, thereby causing the molten metal to lie quietly in the mold and the resulting casting to be smooth and handsome. A patent has recently issued to the same men for the use of an alloy of aluminum and iron for such molds, this being claimed to secure the same desirable results without the paint. The specification of the patent says referring to the former painting process:

"We have found by a series of experiments that a similar result can be accomplished by mixing aluminum intimately with the iron that forms the body of the mold, the percentage of aluminum being not less than 2 or more than 10 per cent., as less than 2 per cent. fails to accomplish the desired result and more than 10 per cent. results in detriment to the mold, due to the molten metal in such proportions eating into the iron mold. In carrying out our invention we first melt the iron (that is to constitute the body of the mold) and then mix therewith from 2 to 10 per cent. of aluminum. Our best results have been attained by adding 5 per cent. of aluminum to the molten iron. After the aluminum is thoroughly mixed with the iron, the metal is poured into a suitable mold to form the mold for making the brass casting, and the brass casting when produced will be found to have a smooth, perfect surface and will be homogeneous throughout."

A recently graduated apprentice in a railroad shop writes to *Railway Age*: "I finished my course a few months ago and was immediately put on shop improvement work at the maximum rate of pay for machinists. You are at liberty to use this information without my name or the name of the road." We ought to have both names, as both seem to be out of the usual run.

A Worm Driven Auxiliary Table for a 16 by 24 Niles Boring Mill.

BY H. G. KNODERER.

A problem which confronted the mechanical engineers of the Westinghouse Electric & Manufacturing Company during the building of the 5,000-kilowatt alternating-current generator for the Interborough Rapid Transit Company, of New York city, was the devising of a method for turning down the core, end plates and end bells for these machines. The largest diameter to be dealt with was 35 feet 8 inches, which was larger by 5 feet radius than the capacity of any boring mill in the East Pittsburg shops of this company.

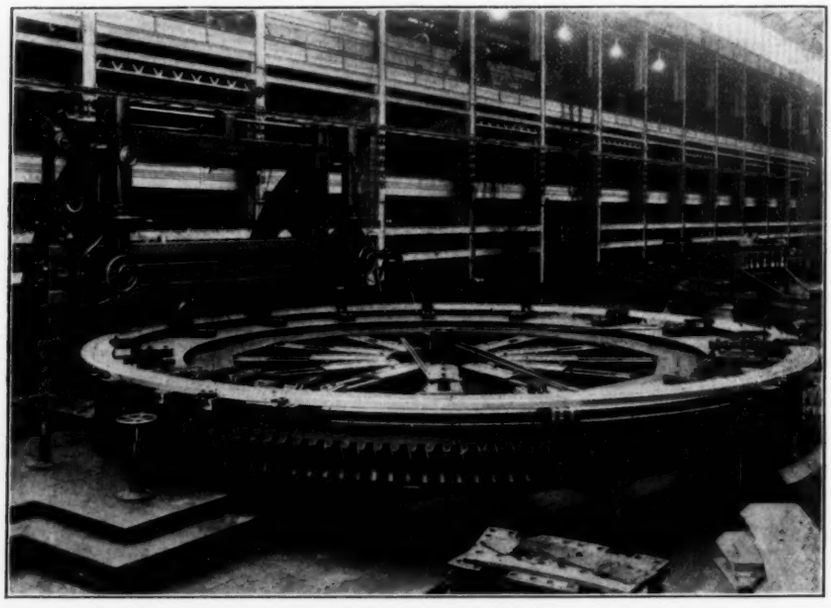


FIG. 1. EXTENDED BORING MILL.

A 16x24 Niles boring mill with a specially constructed 10-foot extension of the bed plate was then rigged up. Placing the housing back upon this special bed-plate allowed a working diameter of 36 feet. The problem now consisted of building an auxiliary table.

Outrigger I-beams were built upon the primary table, twenty-four being used, placed in pairs. The pairs were fastened together by clamp plates placed upon each pair and bolted to the primary table. The outriggers were spaced by distance pieces, one being placed near the radial centers of the I-beams, another close to their extremities, and the third central to the first two pieces. The outer terminals of the I-beams were supported by sliders which travel over an annular rail. A sole plate, having short extensions on its bottom for legs, was bolted to the I-beams, under which, with legs coinciding with those on the extremities of the sole plate, was bolted a slide. The rectangular spaces so left were for wedges which were placed in position before the sole plate and slider were bolted together, and were used to correct the sag due to the weight on the I-beams. Each wedge was operated and secured by a set of set bolts at its ends. The annular rail shown in Fig. 2 has a flat sliding surface and was cast in segments. At intervals of about three feet along the rail is an oil pocket into which was dropped an oil roller fastened to the table and traveling directly in front of the slider. This rail was built upon and bolted to pedestals.

Upon the extremities of the I-beams was bolted a table plate divided into segments and upon which the work to be done by the machine is clamped or bolted, the plate being of sufficient width to allow much of the work to be placed directly upon it. When this could not be done, the ordinary outriggers, such as are used on any boring mill, were bolted upon the table and the work rigged upon them, as shown in Fig. 1.

The mill was given a trial as it then stood, driving from the center as before the auxiliary table was built. Work was put upon it and a cut was taken, but it was found that it operated only fairly successfully because of the jarring due to the cut being so far from the driving power. It was then decided to apply the driving power to the ends of the I-beams by means of worm gearing.

A worm gear was rigged up upon the rim of the table and was driven by a worm screw coupled to a type C alternating-current motor thru a system of gears, as shown in Fig. 3. The building of the large worm gearing formed the chief feature of interest in connection with this auxiliary table. The worm gear casting was made to fasten to the table plate at the top and to the under part of the lower flange of the I-beams. There was no machining of any kind whatever done upon the worm gear, the roughest parts being taken off by hammer and chisel. The worm was made in the usual manner on a lathe. The motor is of constant speed, being geared down by a small worm gear. This gear is directly connected to a shaft upon which was keyed a gear meshing with a gear direct coupled to the large worm of the table gearing.

A pair of gears were made which, being interchangeable, gave four speeds to the table. On the pattern for the large worm gear was made an outward extension directly above the teeth, forming a shield for the gearing, preventing chips from falling between the teeth. After the table was built, a shield was constructed around the driving gear and about the rim of the entire table, this screen starting from the bottom of projecting lugs on the worm casting, as shown in the view of the complete machine, Fig. 4.

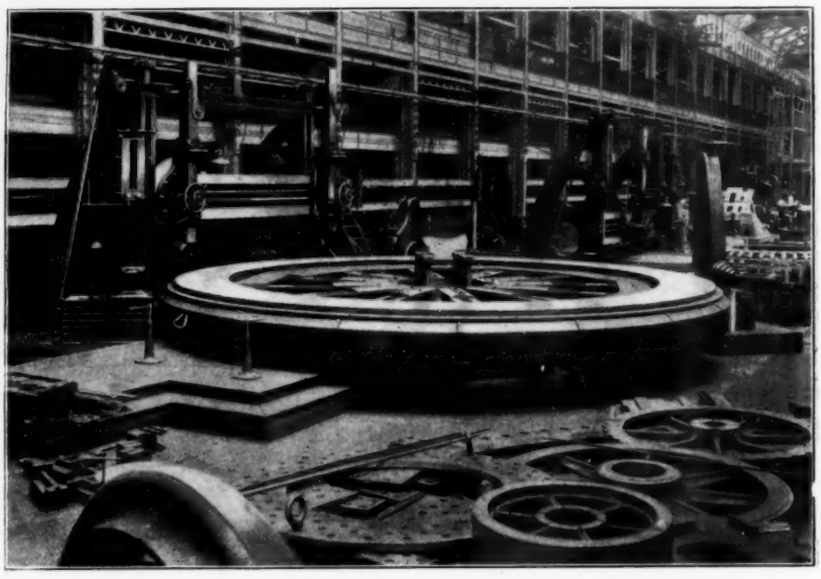


FIG. 4. EXTENDED MACHINE COMPLETE.

It was found upon trying the table that the gearing gave perfect satisfaction, running smoothly and evenly.

Over-Systemizing.

BY F. B. DUNCAN.

Systematic management of manufacturing operations is certainly a necessity, and a "reasonably accurate" record of the cost of the finished product is vital to the successful prosecution of any manufacturing business.

Fads are troublesome things, and there are indications that this subject of "production engineering" and "systemizing" is rapidly developing into such.

A proper amount of system decreases the cost and improves the quality, and should also furnish a "reasonably accurate" record of the cost of the finished product to serve primarily as the basis for the selling price. The term "reasonably accurate" record of cost is used advisedly, for it is at this point that most systems fail, by reason of endeavoring to get the cost too accurately. This term "reasonably accurate" is also to be understood in its relative sense, for a cost of a battleship that arrived within a few hundred dollars would be "reasonably accurate," while the cost of a twist drill or a tap, in order to come within this term, should be within a fraction of a cent.

Too much system is a bad thing for many reasons. It increases the cost and decreases the output, and is a much worse thing than too little, for the victim generally hugs the fatal thing and proudly exhibits his horrible entanglement of red, blue, green, yellow, pink and piebald cards, vouchers, specifications, bills of material, drawing lists, requisitions, purchase orders, production orders, shipping orders, invoices, files and folders, indexes and cross-indexes, etc., etc., in all the colors available at the printer's, duplicated, triplicated and ever upward in number of sheets, till he winds up with onion skin paper, because his typewriter won't take in any more, and asks his visitor if he doesn't think it is a fine "system." Generally the writer turns the matter off and makes the owner feel good by remarking that "it must have cost a lot," for the more it cost to install and the more it costs to operate the better the unfortunate owner seems to think it is.

When an inquiry is made as to the cost record, the reply is generally reluctantly made: "Our costs are high and don't seem to be anywhere near what they should be, but we haven't got our system working right yet; when we get it working it won't cost so much to run it, and we will know to a fraction of a cent just what our stuff is costing us."

That time never comes, for in the foolish struggle to preserve the accuracy of a system of bank accounting in the handling of the shop records of manufacturing operations the collapse of the firm takes place, or the bitter experience of financial stress opens the eyes of the "systematic victim," and while there is yet hope, the stifling bands of red-tape are cut off. Too often a severe reaction sets in and, for a time at least, "the last state of that man is worse than the first."

It is not my purpose to advocate a return to the conditions surrounding the early stages of manufacturing, when the whole office force was under the Old Man's hat and all records were carried in his vest pocket; nor is it my purpose to minimize the able work of many gentlemen who are making a business of "production engineering" and systematizing manufacturing operations; but what is greatly needed at present in many, both large and small, establishments is a "systematic simplifier," or a *"deduction engineer"* to eliminate red tape and *deduct* from the office staff till the producing element can not only carry the load, but also show a profit at the end of the year. What the manufacturing industries in the metal-working line need to-day is not so much *more system* as more *sense*—good, old-fashioned common sense.

It is to make a plea for the sane use and and not the abuse of shop systems that this article is penned. Many firms are suffering from an overdose of a good thing, and several bad examples have recently come to the writer's attention.

One very large firm for twenty years never passed a dividend; three years ago it was thoroughly "systematized" and has never paid one since and recently called a meeting of its creditors.

Another very large firm thoroughly tangled up in a faddish system after operating a number of years arrived at the place where their liabilities exceeded their assets by over $400,000; they cut loose from their red-tape and in less than six years discount all their bills and have a cash surplus of $500,000.

Another "horrible example" of "over-systemizing" was a firm that had at work a force of nearly one hundred employees and was producing merchandise of the value of $125 per day, their pay-roll alone being over $150 a day. In four years after the elimination of their "system" the same force of men with the same tools were producing over $1,000 per day of the same class of merchandise.

While these cases may be exceptions, yet the condition is sufficiently serious to warrant a note of warning.

In the enormous growth of the metal working industries especially many slip-shod methods of management and of computation of costs were and are doubtless in vogue, and in order to successfully compete to-day it is necessary to arrive at a fairly accurate knowledge of the cost of the finished product, and when the term "cost" is used in this article the *ultimate cost* is meant, comprising labor, material and general expense of operating the business.

To attain this knowledge is not difficult and the methods vary with each different plant, yet the principles are forever the same, and granting sufficient time from his other duties to give it a little attention should not be a difficult matter for any competent factory manager.

In concluding I would suggest again that we mix our shop and office systems as the old painter said he mixed his colors, "with brains, sir."

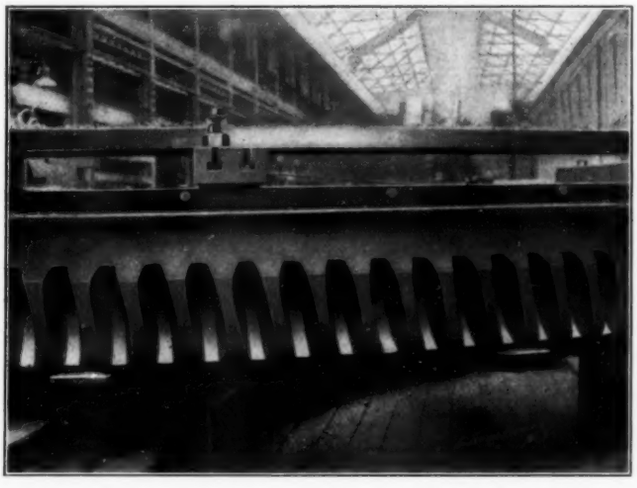


FIG. 2. WORM GEAR AND SUPPORTING TRACK.

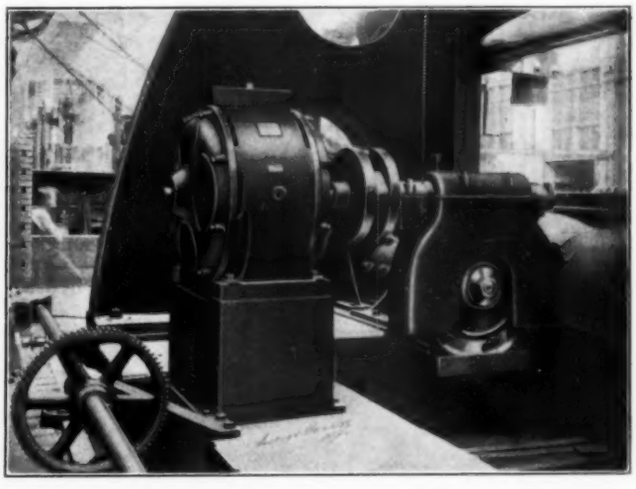


FIG. 3. ARRANGEMENT OF DRIVING MOTOR.

Things That Are Usually Wrong—I.

BY JOHN E. SWEET.

Whoever designs a new machine or an improvement on an old one conceives of some feature or ruling object of his design or some feature that is an improvement on present practise and neglects the other features—simply follows common practise without considering whether the other features may not be as open to improvement as the special feature he is working out. As an example, the designer of a new lathe for high-speed steel or the electric drive invents a new headstock, puts more iron in the bed, sticks under it the old supports, puts on the old tailstock, uses the old slide-rest and the compound rest without a thought as to whether there are any better ways. I know how this is because I have done the trick myself over and over again, and the object of these comments on the things that are usually wrong is to stimulate designers to avoid them.

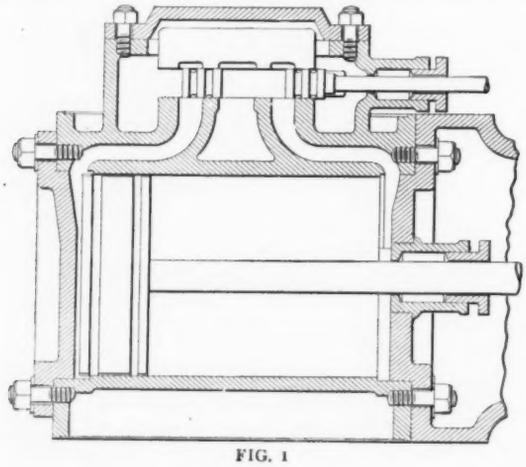


FIG. 1

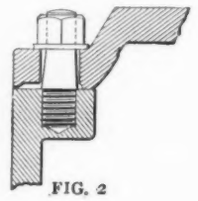


FIG. 2

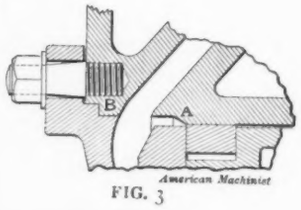


FIG. 3

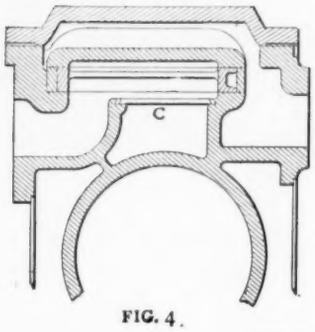


FIG. 4.

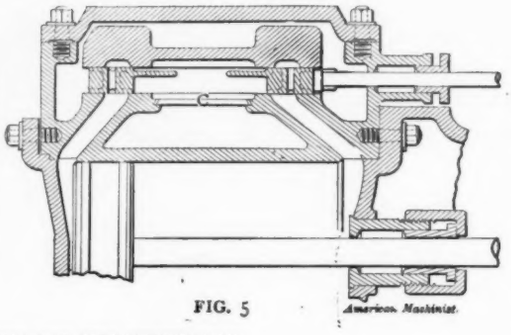


FIG. 5

THE RIGHT AND THE WRONG WAY.

An old machine company thinking they would go into the high-speed, high-class, shaft-governed, steam-engine business employed a draftsman or mechanical engineer who had some original idea as to a shaft governor. He followed precedent in all things except the governor and made his drawing of the cylinder.

He had found that in order to get in his valve motion the valve needed to be a considerable distance from the cylinder, otherwise there was no special requirement, and Fig. 1 shows how he made it. It looks so much like common practise as to call for no particular criticism, and yet there are a half dozen things about it that are far from being as good as they might be or as they ought to be, to be called twentieth century high-class steam-engineering practise.

First, the studs go thru into the steam chest, which is all wrong, to avoid which calls for the cylinders being an inch or two longer, and besides, if the best is wanted, the ends of the studs that tap into the cylinder should be one size larger than the outer ends, as in Fig. 2. When a stud of this kind is broken off, it can be removed without drilling out the piece in the casting. It is sure to part outside the cover, as the weakest point is at the bottom of the thread under the nut, rather than at the bottom of the thread where it goes into the casting, and is one size larger.

As the valve is a balanced valve, there is no objection to making it as long as possible, so as to reduce the length of the steam passages as shown in Fig. 5. The steam passages are shortened still more by making them straight, and this reduces clearance and makes them easy to clean.

The counterbore should end as at *A*, Fig. 3, so that the piston may be pushed into the cylinder without the rings having to be held in by some extra device. Some of the engine builders who aspire to the Corliss type still persist in leaving a square shoulder. The joint between the cylinder and cylinder head is too wide and is better protected if as at *B*, Fig. 3; besides, by this plan the condensing surface in the cylinder is reduced. The joint between the steam-chest cover and steam chest is too wide also, and should be as close to the bolts as practicable as in Fig. 2; the flange of the cover needs to be thick so as not to spring between the bolts. If the joint is only about one-quarter of an inch broad and well machined, there is no occasion to scrape, grind, nor pack the joint. Simple truly machined surfaces, bolted up, will be steam tight.

There is no necessity for two passages thru each end of the valve, and the ledges or shields in the exhaust opening in the valve are a necessity to prevent the exhaust steam from cutting away the cover-plate bridges. These two passages thru each end of the valve show two things—the persistency of habit and that the copyist copies the bad things with the good. For some reason, I do not remember now what, I put in the two thru passages in my early engines, and for just no reason at all I continued putting them in for years in all sizes of engines, and about all the copyists put in the two passages also without taking the trouble to question why.

The plug in the frame for the stuffing box if driven thru from the inside, as shown in Fig. 5, avoids cutting the thread and proves to be in practise all that can be desired. By caulking in the plate in the exhaust chamber as at *C*, Figs. 4 and 5, the exhaust can be completely cut off from the cylinder wall, thus reducing cylinder condensation.

The Great Engineer of the Subway.

Those who have known most of the inception and progress of the vast and difficult work of engineering now practically completed by the opening of the New York subway are least satisfied with the measure of recognition and appreciation which has been accorded throughout the current press accounts of the inception and progress and completion of the work to *the* engineer of the work. It is with considerable pleasure therefore that we reproduce here the tribute of the *New York Times* to William Barclay Parsons:

"The brief but sufficient epitaph of Sir Christopher Wren in St. Paul's, 'Si monumentum requiris, circumspice,' would be the most fitting response Mr. Parsons could make to such words of congratulation as may be tendered him by the multitudes who flock into the subway to wonder at it and admire it. This monumental work identifies him with the greatest achievement of the time in municipal engineering, and the manner of its execution establishes his reputation on an enduring basis.

"Mr. Parsons' connection with the subway began with its inception. He was the principal assistant of Mr. William E. Worthen in a study of its many and anxious problems which came to nothing. He held the same relation to Mr. John Bogart, who succeeded Mr. Worthen and filled

the position for a brief period. Meanwhile, his capacity and still more remarkable adaptation to the work had attracted the attention of the commissioners, and with the retirement of Mr. Bogart he became chief engineer. It is to the credit of the commissioners that they have given him a free hand, and that in matters of technical judgment they have been from the first a 'committee of concurrence.' An invaluable service to the city was the assistance he gave the late Judge Henry R. Beekman in drafting the Rapid Transit act—the best piece of legislation of its kind ever framed. By him the final surveys were made and the problems of construction studied. The work was not pushed until 1900, when it may be said to have really begun.

"In the early stages of his work Mr. Parsons encountered many and serious difficulties. A more plastic and less conscientious man would probably have found them insurmountable. In the organization of his staff personal considerations were dismissed and 'influence,' social or political, had no weight. His appointments were all made with the strictest and singlest regard to merit, and for no other consideration than fitness for the work to be done. As the result of capacity, combined with rare tact and diplomacy, he has carried the great undertaking to successful completion, not only without developing personal animosities, but with the respect and affection of all who have worked with him in any relation.

"Mr. Parsons is still a young man, but he is a great engineer. He combines quickness of perception with the thoroughness which permits him to work his way patiently thru a mass of intricate details, neglecting nothing. Always willing to listen to suggestion or argument, and desirous of the fullest and frankest expression of opinion from all who work with him, he reaches his conclusions in the light of the best advice he can secure; but having made up his mind what to do and how it should be done, he is as inflexible as one of his own steel columns. His study of problems is too thorough to leave room for any wavering or infirmity of purpose when the critical moment is reached. Gifted with a fertile imagination, no man is more completely exempt from servitude to the traditions and conventions of his profession, but none is more appreciative of what is established by experiment and experience. His mind naturally tends toward the solution of problems in engineering along safe lines and by convenient means; but this has not restrained him from making a radical departure from what engineering traditions would have prescribed. Everything has been thought out carefully and thoroughly and nothing accepted and approved until it was certain that it was the best that could be done in the circumstances. In every detail the completed subway represents the 'state of the art,' and in not a few particulars it establishes new standards to which later work must conform.

"Mr. Parsons is a man of rare personal charm, and his unfailing courtesy and self-restraint impress all with whom he has business relations. In his case patience and amiability do not indicate weakness. His yes and no mean quite as much as if announced with less consideration for those to whom they are addressed, and have exactly the same significance for the unskilled laborer on the work as for the commissioner in the board room. His is 'the arduous greatness of things done.' He deserves well of the people of New York, and his place in their respect and regard is established."

Differences in Hoisting Capacity.

Both of the following items we clip from the *Engineering and Mining Journal*. They strain the reader in opposite directions.

Four and one-half tons of coal per trip, from a depth of 444 yards, at the rate of 80 trips hourly, is the record of the compound winding engine erected on the Sherwood colliery, near Mansfield, Nottinghamshire, England. The cylinders are 32 and 53 inches in diameter, with a 66-inch stroke. The boiler pressure is 150 pounds.

Probably the greatest weights carried on the backs of men for any distance are the loads of ore brought up from the mines of the Andes by the miners of Chile. In a copper mine in a ravine leading from the main range of the Cordilleras, all the ore is carried a vertical distance of 450 feet, and the average weight per man is 250 pounds. This load is carried up ladders made of notched trunks of trees, set almost upright, one touching the other.

"The enlargement of the social horoscope" is one of the benefits attributed by a contemporary to the rapidly growing use of "power pleasure craft," but whether the alleged enlargement is a good thing or a bad thing, who knows?

Gas Flasher.

Our contributor, Corneil Ridderhof, and G. M. Johnston, of Grand Rapids, Mich., have gone a little outside of the machine-tool line and invented an apparently highly practical device for flashing gas lights. Fig. 1 shows the device with the upper part of the case broken away, exposing the valve and means for its operation to view. Fig. 2, a view at right angles to that of Fig. 1, shows the float chamber, the reservoir and the passage between these. Its operation is exceedingly simple and as follows: Valve *A* being closed, the pressure of the gas entering at *B* forces the liquid from chamber *C* thru tube *D* into reservoir *E*. This lowers float *F* and causes disk *G* on rod *H* to open valve *A*. Gas now passes out to the burners (which are provided with pilot lights) and this reduces the gas pressure in the chamber sufficiently to allow part of the liquid to re-enter chamber *C*, raising the float and causing disk *I* to close the valve.

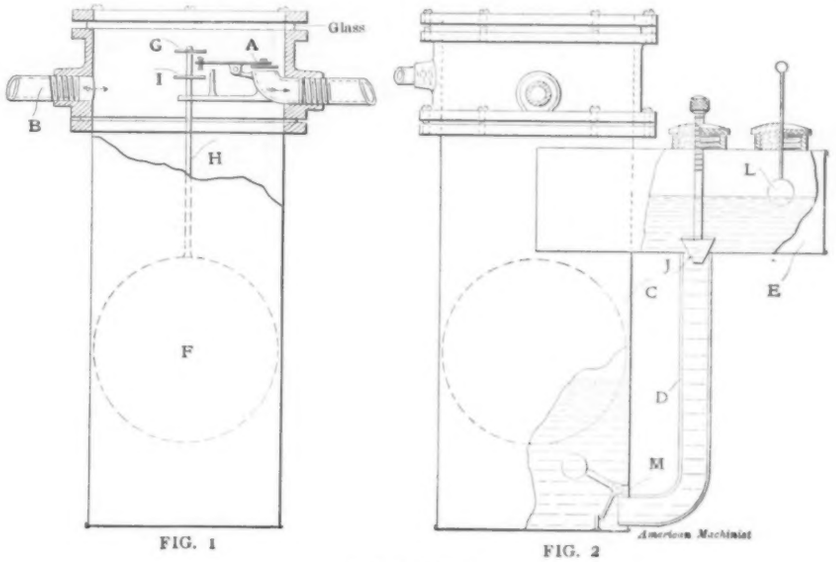


FIG. 1 FIG. 2

GAS FLASHER.

after which the operation is repeated. The frequency of the flashes may be regulated by valve *J*, which controls the freedom with which the liquid passes to and fro. *K* is a connection for the pilot lights, but when the sign in which the lights are flashed is outside it is desirable to run a separate line of small pipe for these. Then the pilot lights will burn continuously and not be turned off with the apparatus. Float *L* shows the motion of the liquid when in operation (when not in operation the liquid in both apartments is obviously at the same level) and also indicates when it is necessary to replenish the liquid. The amount of liquid may vary considerably without much disturbing the flashing operation, a surplus or shortage affecting merely the relative length of the "light" and "dark" periods at the burners and also, of course, the pressure at the burners. *M* is a safety valve which, normally held open by its float, closes if for any reason the liquid level should drop too low.

Shrinkage Troubles and Methods of "Feeding"*

Unsoundness in castings is produced by one of three things—a "blow hole," "dirt hole" or shrinkage. Rarely if ever are two of these factors combined. It is, however, possible for dirt to lodge in a section that would also shrink.

A few days before writing this paper I received a defective casting, and was asked to indicate the cause of the defect. This special valve casting had to stand a hydraulic pressure test, which, when applied, caused a leakage or sweating of the casting at the pouring gate section. The first thing I did was to apply a magnifying glass. This enabled me to be very emphatic in attributing the trouble wholly to shrinkage, and I wrote the parties that if they would change their pouring gate to a lighter section I believed their trouble would cease. I heard no more from them.

The glass showed the section that leaked to be of an open, stringy structure, reminding one of a lot of peas tied together with very fine thread. The open spaces were entirely free from dirt and the solid section of the casting was of a close, uniform density. There was not the least sign of dirt being confined between the spaces or open grains of the iron. Some might refer the trouble to confined gases causing blow holes. These do not exist as an open-grained, stringy structure as in some forms of shrinkage. Sponginess, or holes due to confined gases, appears in cavities surrounded with a structure denser than that adjoining the defects; and the surfaces of blow holes often appear as smooth and dense as the interior of a piece of blown glass. In fact, the formation of holes by expansion of air or gas is upon the same principle. Molten iron or glass is easily separated by air or gas pressure, forming a void space before solidification, and molten iron will liberate gases up to a certain decrease in its temperature, just as air can escape from water before it freezes. Let one fasten the above facts in his mind and there should be no difficulty in determining whether a defect is caused by dirt, confined gases or shrinkage.

There are several different methods for preventing shrinkage evils in castings. At present we have no terms or symbols to designate one method from another, and it appears to me that to have symbols that could be universally applied would prove of service to all interested. The terms I offer to cover the present different forms of general feeding are: 1, interior rod feeding; 2, exterior rod feeding; 3, statical pressure feeding; 4, chill feeding; 5, compression feeding. The first and second terms may be used in some cases with the word rod omitted. The question of symbols is taken up at the close of this paper.

While skill in placing proper feeding heads and in feeding can accomplish much in preventing the evils of shrinkage, there are forms that baffle the most skilled attempts. The great difficulty in obtaining a perfectly solid body in many forms of bulky castings is due to the fact of the exterior solidifying before the interior, and the impracticability oftentimes of conveying to the part solidifying last, the hot metal that will fill the void left and thus compensate for the shrinkage. In the solidification of a casting the bottom and sides will solidify to a greater thickness than the top until the whole has become solidified. As an example a cube, as in Fig. 1, would have the part last to solidify at about the hight seen at *A*. If the one feeding such a casting can maintain open communication between the hottest part *A* and the feeding head at *B* until *A* has solidified, he can produce a solid casting; otherwise he will fail. What works against reaching *A* with occasional supplies of hot metal in such castings is the early cooling off of the top body at *C*. It is difficult to keep it in a liquid state to the same length of time that the metal is liquid in the more central section at *A*. This is generally accomplished by the use of what is termed a "feeding rod," seen at *D*, Fig. 2. This is kept in motion up and down as well as sidewise. Its action keeps mixing the metal in the feeding head *E* with that in the interior of the casting. This "interior rod feeding" applies to all forms of feeding where feeding heads are placed directly upon the top or cope surface of a casting.

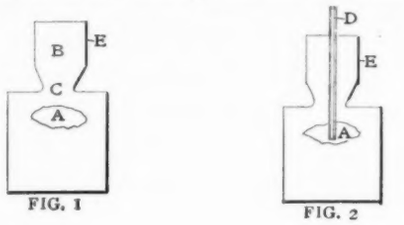


FIG. 1

FIG. 2

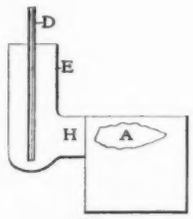


FIG. 3

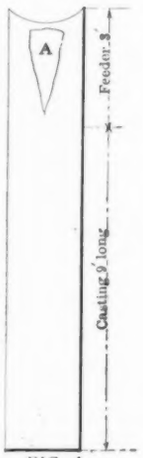


FIG. 4

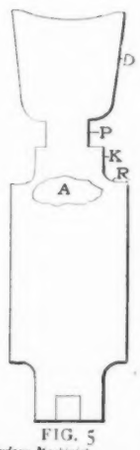


FIG. 5

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DIFFERENT METHODS OF FEEDING CASTINGS.

"Interior rod feeding" secures a perfectly solid casting, providing the person working the feeding rod *D* can keep a liquid communication between a feeding head and the interior of the casting, or that part last to solidify. To do this, as all experienced molders know, requires the greatest care and skill, and it is to be said that without these more harm than good can be done. The great difficulty with this method of feeding is in keeping the passage for fresh supplies of hot metal open until the hot spot *A* has solidified. The term "hot spot" was first brought out by a writer in the *Foundry* several years back. The cost of chipping off large feeding heads, and the great danger of cracking some castings in doing so, cause most persons to use smaller feeding heads, as a rule, than should be employed. Were it possible to have feeding heads as large as the body to be fed, similar to the feeding heads for cannon, plain shafts, etc., seen at Fig. 4, there would be little difficulty in obtaining a solid interior in bulky castings.

In exterior rod feeding, which covers all that class of work having the feeding head *E* set to one side of the casting with a connection cut between the two as at *H*, Fig. 3, a feeding rod *D* is generally used, the same as in Fig. 2. The main difference between the Fig. 2 and Fig. 3 plans lies in the latter never permitting the feeding rod to penetrate the casting or its "hot spot." This militates greatly against obtaining a perfectly solid casting unless the feeding head *E* and connection *H* are as bulky as the casting, and even then the earlier solidification of the sides ahead of the upper center body of the casting will prevent the connection *H* from conveying metal to the hot spot *A*. It is to be said, however, that exterior rod feeding, in the hands of the majority of molders, can be generally relied upon to give a more solid casting than the interior rod feeding of Fig. 2. At least there will be more of the external appearances of soundness in rough castings by the plan of Fig. 3 than by that of Fig. 2, whatever may be the internal conditions of the hot spot. Some years back a writer in the AMERICAN MACHINIST stated that he could make solid castings without feeding, or "pumping," as a few call it. He must have been deceived by external appearances, or well acquainted with the deceptive qualities of exterior feeding, and wanted others to accept external appearances to sustain his claims.

This third form includes all that class of feeding employed in the casting of cannon, shafts, rolls, etc., cast on end,

*A paper slightly condensed read by Thomas D. West at the Boston meeting, Oct. 12, 1904, of the New England Foundrymen's Association.

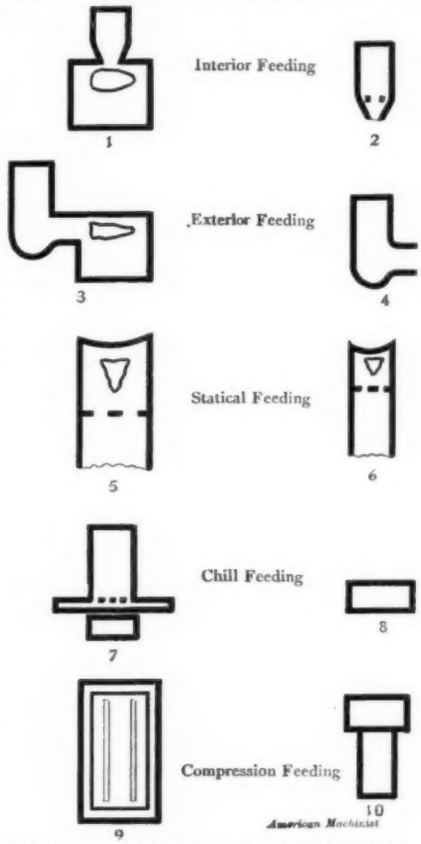
where the feeding head is often made the same area as the casting, or larger, extending it so that the whole may often appear like one casting without a feeding head, when taken from the mold. The principle involved is seen in Fig. 4. Here the shaft casting wanted is 9 feet long, having a feeding head of 3 feet long to make the casting solid. At *A* is seen the hot spot, or the body from which the metal descends to supply the shrinkage of all below it. In depending upon self-feeding, long feeding heads are necessary, and it is generally advisable to feed with a rod a few moments after adding fresh supplies of hot metal in the head, and this should be kept well covered with blacking dust, etc., to prevent the escape of heat as far as possible after every addition of new metal and a few rod feedings.

In the case of rolls that have the neck *K* smaller than the body, in connection with wabblers *P*, it is very necessary, if employing feeding rods, to use one after every fresh supply of hot metal, in order to feed up the hot spot *A*, and at the latter end of the feeding the rod must be constantly used with the greatest skill, otherwise shrink holes or sponginess will be found in the neck at *R* when finishing the rolls. Especially is this true of rolls having large bodies and small necks. Wabblers in roll molds are so effective in closing up the connection between the body *K* and head *D*, to prevent new metal reaching the hot spot *A*, that some roll founders have left them to be machined to form after cutting off the feeding head. Where the wabblers are omitted some depend almost entirely on self-feeding of the head, by covering it well with blacking dust after every fresh supply of hot metal. In fact, this is often much safer than depending on the majority of molders to make rolls solid by working a feeding rod.

The secret of making solid rolls is to keep reaching the hot spot with fresh supplies of hot metal until it has solidified, and he that can best do this will be least likely to find shrink holes or sponginess at *R* when finishing the rolls, or the neck breaking off when they are in use. Many molders think that as long as they can keep the top and neck body of their feeding heads in a good liquid state they are doing all that is necessary; nevertheless these remarks on the advisability of reaching the hot spot with all the hot metal possible, as well as keeping the top of the feeding head good and hot, should cause some to do a little deeper thinking.

The method of chill feeding seeks to prevent the formation of a hot spot and consists in forming of iron any section or part of a mold for a casting that gives trouble from shrinkage, forming all other parts of the casting in sand. The chill or "chiller," as more recently termed, causes the part or parts that would be among the last to solidify, if formed of sand, to solidify in closer unison with the lighter parts which would draw metal from it, to supply their shrinkage. This plan is of late origin and many use the method to good advantage.

It would be of advantage to have signs as well as words to designate feeding methods. In making out orders for castings, steel or rubber stamps could be used to mark on orders or chalk to mark on patterns any methods designated in Fig. 6. The foreman would thus have better assurance of molders following his desires in the choice of methods. If the foreman takes no interest in the matter but leaves it with the molder to do as he pleases, the knowledge that order blanks have provision for shrinkage symbols should cause him to recognize it as something he should



PROPOSED SYMBOLS FOR INDICATING MODE OF FEEDING.

study more and have better control of. The sizes of feeders and their positions can be marked on the pattern, and if cross bars, etc., will not permit their attachment at the place designated then the molder will feel called upon to consult the foreman instead of going ahead regardless of results.

Drawings also may be marked in some cases with a symbol of the best method to insure sufficient solidity in the casting. If the existence of terms and symbols to designate different methods of feeding did no other good than to cause designers and draftsmen to study the subject of shrinkage and thus make designs that would aid in securing solid castings, a good work would be done.

It is intended that the symbols opposite each other, as No. 1 and No. 2, will indicate the same method of feeding. The only differences are that one form is simpler and takes less space than the other, and that the larger symbol shows the hot spot, which might in some cases attract more attention to the necessity of good, long feeding.

Whether the terms and symbols given herein are adopted by any, this paper may be of benefit in causing recognition of the different methods that can be employed, and thus decrease the evils of shrinkage, giving us sounder castings and insuring greater use of gray-iron products—a consummation which those interested should aid to the extent of their ability and opportunity.

Sherardizing Iron and Steel.

The most effective protective coating for iron and steel is zink, and it has generally been applied by dipping in the molten metal. This galvanizing process, so called, has never been altogether satisfactory, on account of the high temperature and the more or less unevenness and roughness of the coating. A new process for applying the zinc coating has been put into practical operation, which is claimed to possess decided advantages. One point of particular interest about the new process is that iron and steel may be coated with an even deposit of zink at a temperature considerably below the zink melting point.

The first step in the process is to free the iron from scale and oxide by any of the well-known methods. The articles are then placed in a closed iron receptacle charged with zinc dust, which is heated to a temperature of from 500 to 600 degrees Fahr. for a few hours and allowed to cool. The drum is then opened and the iron articles are removed, when they are found to be coated with a fine homogeneous covering of zinc, the thickness depending on the temperature and the length of time. It will be observed that the temperature required to bring about this result is about 200 degrees below the melting-point of zinc. The low temperature required makes the process cheap as compared to the process of dipping in molten zinc, and has the additional advantage that it does not deteriorate iron or steel of small section to the same extent as hot galvanizing. The whole of the zinc dust is consumed; there is no waste of zinc as in the hot galvanizing process. This process is not limited to the coating of iron with zinc; it has been successfully applied to coating iron with copper, aluminum and antimony. It has also been applied to various other metals—for instance, aluminum and copper with zinc. Copper and its alloys subjected to this process are case-hardened on the surface, and can be rendered so hard as to turn the edge of a steel tool.

The zink powder used is the zink dust of commerce, which must not be confused with zink oxide; it is obtained during the

process of distilling zink from its ores. Zink dust at the present time is used for a variety of purposes, and can be obtained in any desired quantity. The average price of zink dust for the year 1903 was £19 19s. ($100) per ton, which is slightly below the average price of virgin spelter. One of the peculiar properties of zink dust is that it cannot be smelted or reduced to the metallic form under ordinary conditions. This property is very advantageous for the new process of dry galvanizing (Sherardizing), as it does away with the risk there might otherwise be of melting the finely-divided zink by overheating the furnace. The receptacle in which the zink dust is placed and heated is preferably air-tight and the air is exhausted to prevent the formation of too much zink oxide; or, if this is not feasible, it is advisable to add about 3 per cent. of carbon in a very fine state of division. If the percentage of oxide is allowed to increase beyond certain limits it is found that the deposits become dull in appearance instead of having a bright metallic lustre, altho good deposits of zink can be obtained from zink dust varying considerably in composition. To prevent the iron receptacle in which the process of Sherardizing is carried on from becoming coated with zink, it is found advantageous to coat the inside of the drum with plumbago or black lead. Articles coated with grease receive as good, if not a better coating of zink than those which are free from grease. This fact is of considerable importance, as it enables machined work, such as bolts, nuts, screws, etc., to be thrown direct after machining into the Sherardizing drum without any preparation or cleaning. The articles, when they have been heated in the zink dust for the period necessary to obtain the thickness of zink required, can be removed while the zink dust is still hot, altho the better practise is to allow the zink dust to cool to a temperature at which the articles can be readily handled, as the deposit of zink is then whiter and less oxide of zink is formed. The new process of dry galvanizing offers many facilities and great economy to those manufacturers who have not sufficient work to keep a large bath of molten zink continuously at work. Articles can be Sherardized at a few hours' notice, starting all cold, as the drums can readily be heated by gas or coke furnaces, the whole operation occupying only a few hours. When the plant is not at work, there is no waste as in the case of hot galvanizing, when the zink has to be kept in a molten condition day and night.

The surfaces obtained by hot and cold galvanizing (electroplating) and Sherardizing are different in each case, but they can readily be distinguished by anybody conversant with the three processes. In the case of hot galvanizing, the surface is spangled, or has the appearance of cast steel. In the case of cold galvanizing, the surface is free from spangles and has a matte or frosted surface, uniform if the work has been well executed. Sherardizing is again distinctive from the two former processes; the general appearance resembles more that of cold galvanizing than hot galvanizing, but is more lustrous and metallic, and is uniformly distributed over the whole surface, which is not the case with the hot and cold galvanizing processes. The Sherardizing process, altho similar to cold galvanizing in some respects, is also similar to hot galvanizing in other respects, inasmuch as the zink alloys with the iron and forms a protective zink-iron alloy intermediate between the zink coating and the underlying metal.

As Sherardizing is effected at a very much lower temperature than hot galvanizing, the temper of steel wire is not reduced as it is in the latter process. A number of steel and iron bolts Sherardized at varying temperatures when tested for tensile strength were found to be equal in strength to bolts which had not been Sherardized.

In practise, Sherardized iron and steel are found to withstand the ordinary corrosive agents to which galvanized iron is exposed to a remarkable degree; even after the apparent removal of all the zink by filing or abrasion the iron is still non-corrosive. This valuable property is doubtless due to the protective action of the zink iron alloy formed on the boundary line between iron and zink.

It is authoritatively stated that the crossties for a railroad now cost twice as much as the rails. The future of the cross-tie seems to be one of the questions most urgent of solution in modern railroading.

Notes on Cranes.

BY A. D. WILLIAMS.

The girders for traveling crane bridges present some interesting points in regard to their development, structurally considered. The first bridges were built by carpenters, then the assistance of the blacksmith was called for to provide truss rods as spans and loads increased. Later built-up metal girders were used, having a single web plate. Figs. 1, 2 and 3 show typical plate girder sections. At first the speed of bridge travel was slow, and high lateral stability was not called for, but as higher speeds were demanded the girders had to be modified to suit the conditions, and the width of the top flange was increased. This meant spreading the girders farther apart to give room for the fall between them, adding to the dead weight in the trolley and bridge. The traversing motor and shafting were supported by brackets carried by one girder, producing a variable eccentric and torsional loading, and unless an unnecessarily heavy girder was employed the lower chord, particularly in fish-bellied girders, would vibrate in a disquieting fashion. Fig. 3 shows a misdirected effort to cure this trouble, gusset plates being added to the stiffeners and riveted to the top flange. The additional metal did not increase the radius of gyration, and hence was wasted.

Figs. 4, 5 and 6 show double webbed plate, or "box" girder sections. The box section is naturally stiff, if properly designed, and is largely used for crane purposes, because it is a very cheap section to build. It is neat in appearance and torsionally stiff also, but it has its disadvantages. The weight of the trolley must be

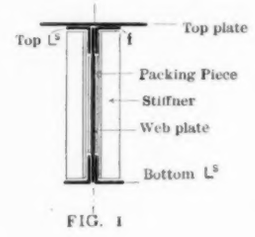


FIG. 1

FIG. 2

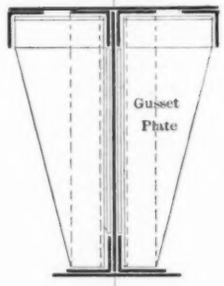


FIG. 3

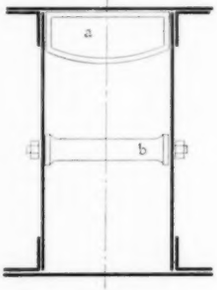


FIG. 4

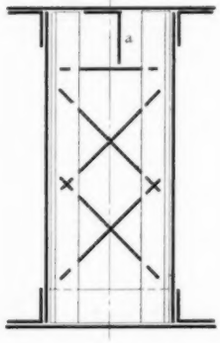


FIG. 5

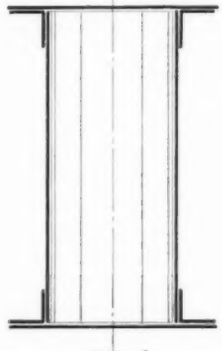


FIG. 6

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CRANE GIRDERS.

carried on its vertical axis, which is midway between the web plates, which means that the top cover plate is a beam having a span equal to the distance between the webs. This load is of course distributed a small distance each side of the wheel by the rail used, but it is found advisable to reinforce this plate, particularly when it is wide. Fig. 4 shows a cast bridging piece *a* used for this purpose, and in Fig. 6 the stiffeners are placed inside the girder and are supposed to fit tightly between the cover plates. Fig. 5 shows a reinforcing angle *a* riveted to the top plate to distribute the load. As it is directly beneath the rail, countersunk rivets must be employed. In the section shown in Fig. 4 the web is stiffened by means of separators *b* and bolts or rivets tieing the webs together. Occasionally outside stiffeners are used, but there is no actual necessity to do this. If the internal stiffeners are properly placed and proportioned they are all that is necessary. A bad feature of many box girders is the very thin and deep web plates with wide stiffener spacing. In some cases the mechanism is bolted to one web only, tap bolts being used occasionally, which can hardly be called good practise. Stiffeners should be placed where required to support brackets and motors, and preferably the bolts should pass thru both webs and a separator. The box section, in common with the plate section, leads to very wide top plates, and this is undesirable, as pointed out.

Fig. 7 shows a type of bridge which is very stiff laterally; it consists of a two-plate girder with "C" clamps over the top, the trolley running on rails carried by the inside bottom flange angles. The "C" clamps are usually lattice connected, and are employed to prevent the lower flanges from spreading under the eccentric load. This is a very stiff construction and is particularly suited for cases where the head room is limited. Its principal disadvantage is apparent when repairs are to be made to the trolley.

FIG. 7

FIG. 8

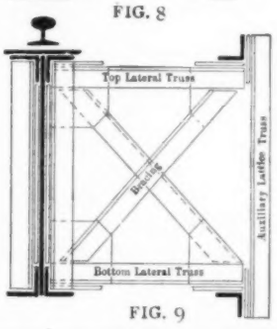


FIG. 9

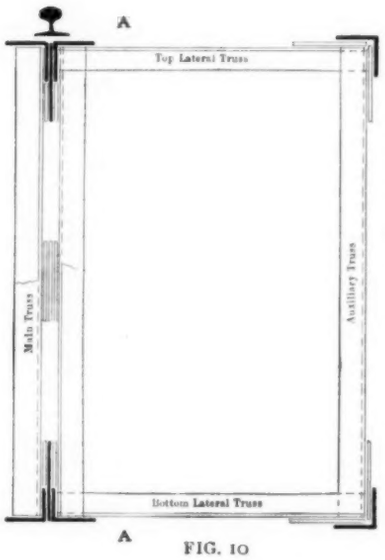


FIG. 10

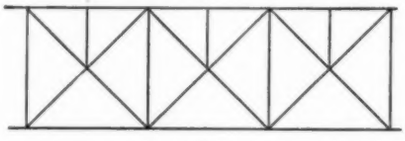


FIG. 11

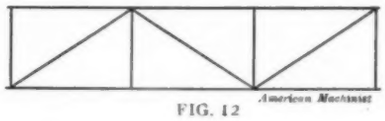


FIG. 12

CRANE GIRDERS.

Figs. 8 and 9 are two very good sections, both of the "hayrack" or auxiliary lattice girder type. Fig. 8 shows two plate girders at right angles, the outer chord of the horizontal being supported by a lattice truss whose lower chord, in turn, is laced to the main girder; "X" bracing or gusset plates at intervals take racking strains. A structure of this kind can be made extremely rigid. Ample opportunity is afforded to support and reach all the mechanism. Fig. 9 is similar to Fig. 8, the horizontal top girder being latticed in this case. The disadvantage of these girders is their somewhat complicated construction and design. The auxiliary girders must be properly laid out and cambered to get the best results.

Fig. 10 shows an all lattice girder of the deck type as used for yard cranes exposed to wind pressure. It is similar to Figs. 8 and 9. Fig. 11 shows a diagrammatic view of the main girder on a line *A—A*, Fig. 10, and Fig. 12 represents in diagram the horizontal lattice girders. The vertical lattice auxiliary girder is similar to Fig. 12.

Thru lattice girder bridges are sometimes used for exceptionally long spans similar to Fig. 7.

About "Lloyd's."

Doubtless many of our readers have, with the rest of the community, vague if not incorrect ideas about "Lloyd's," so often referred to in connection with maritime affairs, and the following, reprinted in *Consular Reports* from *Commercial Intelligence*, London, should be read with interest and profit. It is from a report of an interview with Sir Henry Hozier, secretary of Lloyd's.

Lloyd's is now to the world of shipping and marine insurance what the house of Rothschild is to the banking world. It dates from the latter part of the reign of Queen Elizabeth, and had its origin in a small coffeehouse in Tower street, kept by Edward Lloyd. He was an enterprising man, and thru his business contact with seafaring men and merchants enlisted in foreign trade, foresaw the importance of improving shipping and the method of marine insurance. He was the founder of the system of maritime and commercial intelligence which has been developed into its present effectiveness. Before the time of Edward Lloyd maritime insurance in England was conducted by the Lombards, some Italians, who founded Lombard street; but after Lloyd embarked in the business Britons conducted marine insurance in London. The subjects of marine insurance are the ship, the cargo, and the freight, all of which may belong to different parties. In time of war there is what is termed the maritime risk—danger from accident, collision, and stranding—which is distinctly separate from the risk of capture and seizure by an enemy. This class of marine insurance had its inception in the conditions arising during the seven-year French-English war of 1757 to 1763. Lloyd's moved to Pope's Head alley in 1770, and in 1774 removed to the present quarters in the Royal Exchange. In 1871 Lloyd's was incorporated by act of Parliament. This act defined the objects of the society to be: (1) The carrying on of the business of marine insurance by mem-

bers of the society; (2) the protection of the interests of members of the society in respect of shipping, cargoes, and freights; (3) the collection, publication, and diffusion of intelligence and information with respect to shipping. The corporation of Lloyd's and the committee of Lloyd's, who are the executive body of the corporation, and the secretary of Lloyd's, have practically nothing to do with marine insurance in the way of taking risks or paying losses. Their duty in this respect is to afford marine insurance brokers who wish to effect insurances a place of meeting with those who undertake the risks.

"They say" a Japanese officer has found a way to direct torpedoes by means of wireless telegraphy. This seems to suggest that the game of war may come to be one of opposing wireless devices, and torpedoes may be turned backward as well as forward.

Letters From Practical Men.

Pattern and Core-Box Work for a Column Base.

Editor American Machinist:

The drawings show an approved way (approved by the molder) of making the patterns and core boxes for the foot block or column base shown in section in Fig. 1. Fig. 2 is a side view of the pattern, inverted as in the mold, showing the position of the cores which form the top flange. By the use of these cores the loose pieces to be pulled in after the pattern is drawn are avoided.

Make a square frame 5 feet 9 inches, of 2¾-inch stock, about 4½ inches wide; skirt it around with a piece 1½x1½. Make a center block 2 feet square and 2 feet 6¼ inches high; put on the draw straps shown in Fig. 2. Fasten a 2-foot 6-inch-square plate 2¾ inches thick on the center block; make four center ribs as Fig. 7 to the dotted line, and four corner ribs to the full lines. Make square core-print 17½ inches and 1½ inches thick, and place on the top of the center block with dowel pins. In assembling, attention should be paid to see that the center block is about ¼ inch up from the bottom line of the frame, as shown in Fig. 5. This is to prevent the bottom of the base from rounding.

The molder should strike off a level bed in the pit about 5 feet square, and bed in the loose core-print in the center of the pit. Place the pattern on top of the core-print and cores *A*, Fig. 4, around, as shown in Fig. 3. On top of these put cores *B*, Fig. 6, and fill up with green sand. The mold can be rammed between the openings of the pattern. Place and ram cope and strike off straight; draw the pattern and put in the center core *C*, Fig. 8.

JOHN F. PITZ.

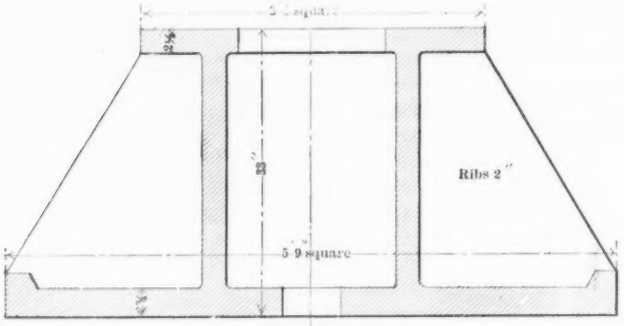


FIG. 1

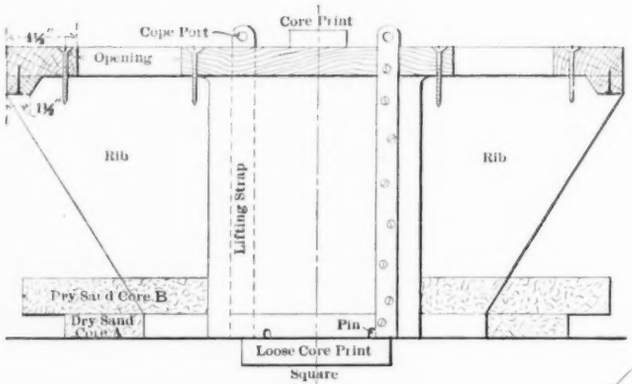


FIG. 2

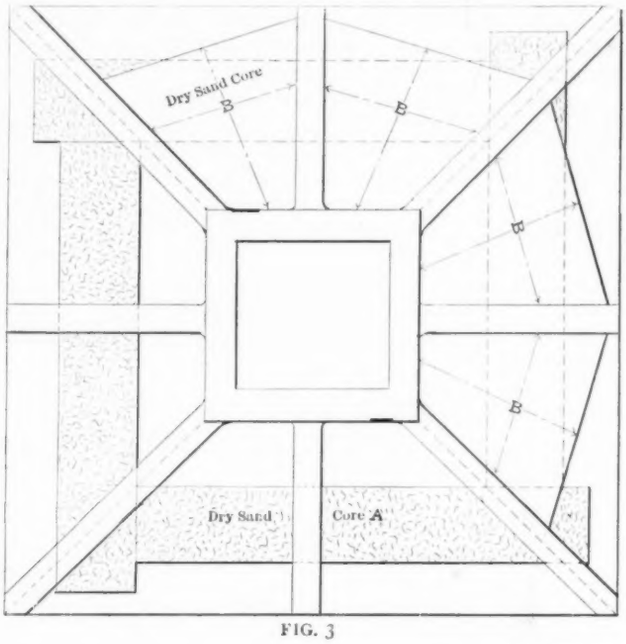


FIG. 3

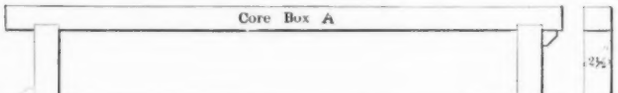


FIG. 4

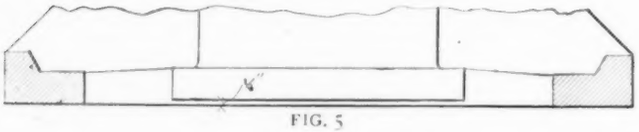


FIG. 5

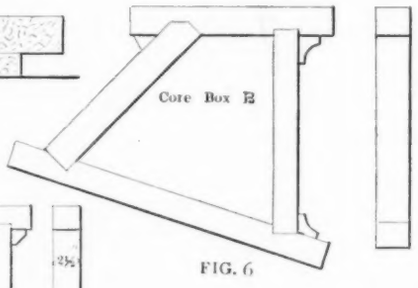


FIG. 6

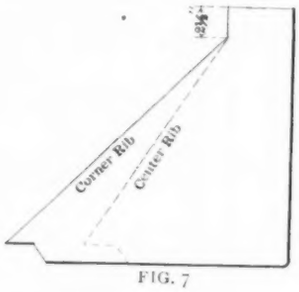


FIG. 7

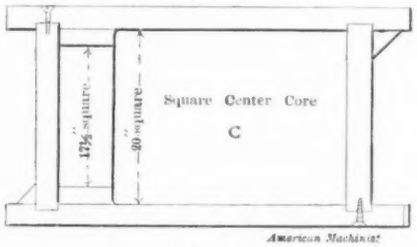


FIG. 8

PATTERN AND CORE-BOX WORK FOR A COLUMN BASE.

In Addition to Money Wages.

Editor American Machinist:

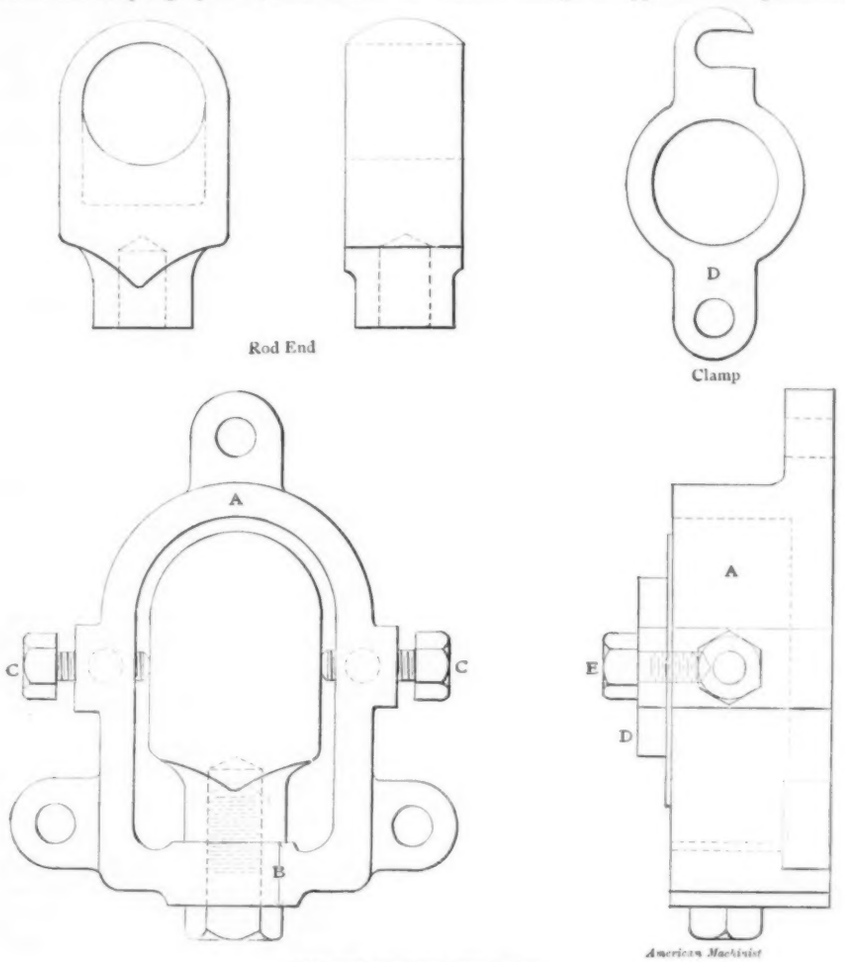
I am glad A. P. Press has brought out, at page 1413, that some firms are "white." At the same time I think it is a very narrow definition of pay to confine it strictly to that which is legal tender. I was sorry, after I saw it in print, that I had not qualified my assertion at page 1210, by saying that the best paymaster does not always hand over the most money. There are a few firms that are very considerate and tactful in their treatment of men, and such rarely have vacancies.

STEELWORK.

Rig for Boring Rod Ends in the Lathe.

Editor American Machinist:

The rig here shown was designed with a view to facilitating the setting of rod ends on the lathe face-plate for boring; it is very simple and cheap to make, and much valuable time is saved by its use. The rod ends are for the valve gearing of Corliss engines. They are first turned, bored out and threaded internally to receive the coupling-up rods, then milled or



RIG FOR BORING ROD ENDS.

shaped on the two flat faces; they are then taken to the lathe again for boring. As they require to be a first-class job, it is rather tedious work setting them; with this fixture, however, all marking out and setting is entirely avoided. The casting *A* is a hollow box, as shown, planed on front and back, and slotted square with the planing on the two surfaces *B* at the bottom for the bored end of the rod to bolt up against. The rod ends are put in and tightened up by the large screw at the bottom, the two 5/8-inch set-screws *C* giving additional security. The steel plate *D* is then tightened across the center by two screws *E*. This clamp plate is not shown in place in the front view, but as shown in the detail it has a hole bored thru the center to clear the drill, and it serves to keep the rod end up to the planed surface on the inside of the box, which is held on to the face-plate by three lugs. Locating pins can be used if required, in which case the fixture is set accurately without any trouble. A different rig is required for each size of rod end when the distance from the center of the hole to the bottom end which rests on *B* varies.

L——, England. DANUM.

School Drawings.

Editor American Machinist:

At page 1237 is a short criticism that is correct enough as applied to the particular drawing shown, but is not wholly so as a criticism of the evening drawing schools of Boston. The regular evening drawing schools of Boston are several, handling each year many hundreds of students. These students for the most part are young men, but many old men will be found there also. The teachers are largely draftsmen holding positions in the many manufacturing firms of Boston and its suburbs, and are selected for their abilities both as draftsmen and as teachers. These schools have been running for years and have a regularly laid out course needing at least three years to complete.

It was my fortune to be a student in one of these evening schools for drawing at about 1885. The classes were held in the school building on Tennyson street, as I recall, and it was commonly called the Tennyson Street Drawing School. The principal was Mr. George Jepson, a thoroughly competent draftsman and an excellent teacher and man. The course covered such work as the use of drawing instruments, plane geometry, intersections, and thus advanced to the drafting of regular machine details, and finally the assembled machines. The rooms were well supplied with working models and actual machines that could be, and were, taken apart to be detailed. The men themselves for the most part, came from shops and knew how machines looked, and were running machines ten hours per day. No monstrosity could be worked off on them and no unpractical teacher could hold his position long. The dull men in a shop are not usually found in an evening drawing school five nights in a week, after working ten hours at a machine or at the bench, and the ones that attend know what they are after, and whether they are getting it or not.

I believe no better educational work has been or is being done than in these evening schools, and that the list of prominent draftsmen and superintendents that received their first inspiration and training in them will bear me out in what I say.

Beside the regular evening drawing schools of Boston there are, I have been informed, so-called *educational centers* where anyone can attend and they are allowed to work at or draw anything they may wish to and the drawing is criticised as a drawing only, and not as to its showing a possible machine. For example, a boy may have constructed something that he calls a machine, possibly a lathe, and if he wishes to use that as an object to draw, he is allowed to do so, and if the drawing is an accurate one of the object, it will be passed as all right.

It must be remembered that most drawing schools of the city evening type and those of the Y. M. C. A. kind exist to teach how to make a neat drawing in an accurate manner, and very little attempt is made to teach correct design.

Where the students coming from shops are taught by teachers, themselves draftsmen in practical life, many times from the same shops that the students are drawn from, and when the students are urged to attend by their employers, it cannot be said that the school and the shop are not near each other in interest.

The tailstock as shown is indeed an un-

likely one, and I hope it will be shown to have crept into the Boston exhibit thru an error. It must not, however, be taken as a fair sample of their work, nor must other cities assume that their work is of a superior order because they have no such examples to show. The question to ask of any educational institution is whether its product is better than the raw material furnished them. If it is, the work has been good, even if it might have been better. In most of our cities there are evening schools provided for by the city itself, the young men's associations, the churches, also some by private individuals and by manufacturing firms, and I have yet to learn of the persevering student at any one of them that has not been advanced by such work. H. P. FAIRFIELD.

Worcester, Mass.

A Threaded Lapping Arbor.

Editor American Machinist:

In lapping out rings I have been bothered more or less by the want of a good, fine adjustment for the lap. In the way which I had always used, the lap was adjusted to size by tapping it with a mallet to force it either farther up or down on the taper lapping arbor, which was, to say the least, most unsatisfactory, as the lap was almost sure to move too far. This led me to construct a lapping arbor, as shown,

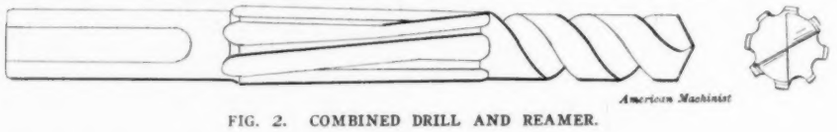


FIG. 2. COMBINED DRILL AND REAMER.

which has given infinitely better results than the old crude way. I do not know of such a lapping arbor having been made by anyone else, still the idea may not be entirely new.

Fig. 1 shows the arbor and lap as in use, *A* being a hardened steel arbor tapered about ½ inch to the foot on which a square thread 10 to the inch is cut. *B* shows the cast-iron lap which is turned, as shown, smaller in diameter on the end at which the threaded hole is largest and has a small hole in it to engage with a spanner wrench. *C* is a collar threaded and split same as lap, also having hole for spanner wrench which acts as a jam-nut for the lap. This collar is not at all times necessary, but I usually use it, as it requires but a small amount of time to adjust it and then I am sure the lap will not turn on the arbor. When I first made a threaded lapping arbor I used a V-thread, but it sometimes did not give satisfactory results, as when the lap was thin enough to be springy, if care was not used in tightening the collar, the lap would be forced slightly outward (expanded) by the angle of the threads. I have not had any such difficulty with the square-threaded arbor, as the lap is forced against a flat surface by the collar and shows no inclination to expand under the pressure of the collar. We now have several of the lapping arbors of sizes covering the range of our regular work which are all provided with the turret lathe tools as shown at Figs. 2 and 3, which reduce the cost of laps to the minimum.

The boring and reaming tool shown in Fig. 2 is simply a combination twist drill and taper reamer, which is of course preceded in the turret lathe operation by a centering tool. The reamer has eight flutes, two of which are cut a left-hand spiral, as shown. This was done after some experimenting with odd numbers of flutes, unequal spacing of flutes, etc., to prevent chattering You will notice that the spiral flutes each cut away a part of the flute on each side of them, thus leaving two entire straight flutes and two spiral flutes. This form of reamer, if properly cleared, will prevent much trouble with chatter marks either in iron or brass, and the small extra time consumed in cutting the spiral flutes will be acknowledged, if tried, to be a good investment.

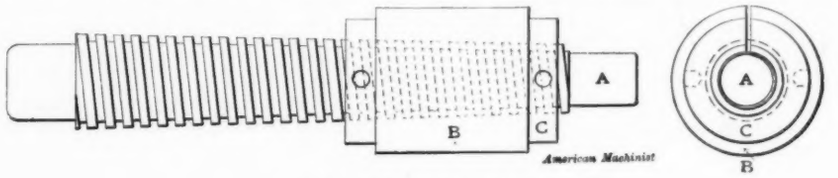


FIG. 1. THE ARBOR AND LAP.

The tap, Fig. 3, is cut eight flutes and is used in the turret lathe to hob out laps. This tap will not, I find, cut freely unless each tooth is relieved slightly before hardening on the top and sides of the thread with a file before hardening. We cut these hob taps somewhat deeper than the thread on the arbor, as, of course, it has to be backed out of the hole it has tapped in the lap, thus leaving a little burr where each tooth was when the tap was started back. In this way we preserve the smooth taper surface finished by the reamer on the inside of the lap and this is the only surface which bears on the arbor. In making laps for thread gages I always cut off, after cutting the thread on lap, one or two threads on each extreme end of lap, as these are usually "fat threads," and will, if left and used, materially change the lead or pitch of the thread in your female gage. I feel sure if those who do considerable of this work will construct their laps and lapping arbors on these lines they will feel that the slight additional cost is well repaid, as the lap is a great time saver in use, and if, as in my case, you do enough to warrant the construction of the simple turret lathe tools shown, your expense should not be any greater than before, as in a few minutes a great many laps may be run thru on the turret lathe. One trouble which a great many have who are not very familiar with lapping processes is in the "scratchy" or marred appearance of their finished work. This, I find, is due to the unevenness of the emery or other abrasive material used in lapping, and is almost entirely overcome by sifting the abrasive material thru a thin cloth. The closer the fiber of the cloth the better the appearance of the finished product.

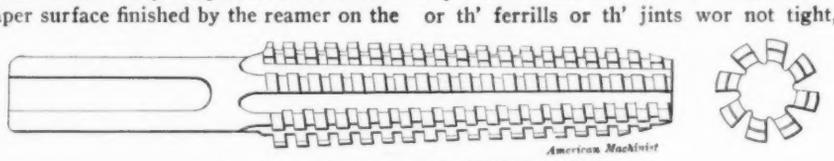


FIG. 3. TAP USED IN THE TURRET LATHE.

I am somewhat given to noticing the "little things" about the shop, and one which comes to mind now is the habit so many men have of laying chucks (which are threaded to fit spindles) on the floor with the thread end down, thus allowing the chips, which are almost always on the inside of the bore of the chuck, to fall into the thread. The next man to use it will have occasion to use the chuck thread cleaner and usually some profanity. The remedy for this small but none the less annoying trouble is obvious.

UNCLE JOSH.

Moriarity Reads Between the Lines.

Editor American Machinist:

"Dixie, d' yez iver raade bechune th' loines? Oi see b' th' daypartmint av new tings at page 1416 in the AMERICAN MACHINIST paaper thot they do be castin' vackums now in th' foundhry."

"How is it done, Mr. Moriarity?"

"Howld on, Dixie, an' Oi'll till yez. Ut's no more loike ut wor when ye was at say. Af th' condinser chubes was leakin' or th' ferrills or th' jints wor not tight, ye hod a baad vackum, ye wud staart from th' Cove o' Cork wid yer Vackum twinty-six, and be th' toime yez raached th' thropics ut was down t' twinty-two, or maybe twinty. An' thin agin there wor circulatin' pumps an' air pumps to pack an' look afther. All thim throubles ye've told me about so often is past now, Dixie."

"Indeed, Mr. Moriarity, this is surely a new departure."

"New daypartchure! Af coorse ut's a new daypartchure. They's a maan in

Lockpoort, N'York, has invinted a machine an' borried some money an' staarted a machine shop b' th' name o' the Bryan Vackum Mooldin' Machine Company."

"But, Mr. Moriarity, a vacuum molding machine is"——

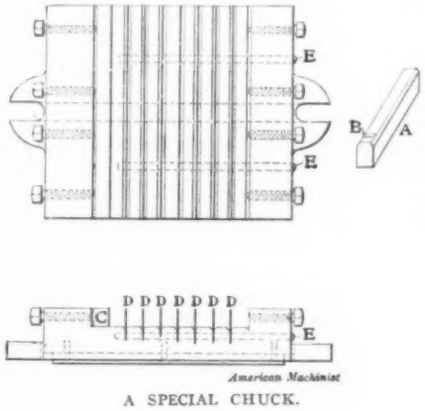
"But me none o' yer buts, Dixie; af a *gear* mooldin' machine is fer mooldin' *gears*, a *vackum* mooldin' machine is fer mooldin' *vackums*. This maan is goin' t' sell th' machines t' plaaces loike Cramps ship yard and th' Morgan iron works an' th' loike. An afther a whoile along comes a chief ingine-eer wid goold braid on th' sleeves av 'im, an' goold buttons, an' a goold diadem in th' front o' th' deep say cap av 'im, an' sez he t' th' boss moolder: 'Me vackum wor domd baad on me lasht vyage t' Vladivostock. Me main injiction wor choked up wid th' raymains o' dead Rooshens. Oi cudn't git moore nor eighteen on th' vackum gage. How much a poun' will yez chaarge me fer a twinty-sivin-inch vackum?' An' th' boss moolder he turns t' Larry, th' handy-maan, an' sez, 'Larry, start up th' vackum mooldin' machine an' cast this gent a twinty-sivin-inch vackum, an' allow fer shrinkage, fer he do be in th' Chinee traade an' don't waant th' vackum t' shrink afther he stroikes hot weather.' Dixie, thus is a graate counthry, an' ut's taakin' th' traade from th' English—th' curse o' Cromwell on 'em!"

DIXIE.

A Special Chuck.

Editor American Machinist:

The illustration shows a handy chuck for either the shaper or the milling machine which was designed at the Cochrane-Bly Machine Works for planing small teeth crosswise in pieces of cold-rolled stock like *B* in sketch *A*, the chuck holding sixteen pieces at one chucking. The main part is gray iron; *C* is a floating



A SPECIAL CHUCK.

piece of cold-rolled key stock for the set-screws to abut against. The set-screws on the opposite side are only adjusted in case of variation in the pieces to be machined. The pieces *D* are of sheet steel —14 gage—and are held in their separate slots by the pins *E*. CARROLL ASHLEY.

Lifting the Punching.

Editor American Machinist:

Referring to the article, "Lifting the Punching," page 1243, the writer says: "The stripper plate will of course be raised a little above the punch face to strip the outside scrap, making it very inconvenient to pull the blank off." Now, as we have had recently a very similar job, it may interest your readers to know how we got over the difficulty. In our case also the punch was below instead of above, to enable the scrap to fall thru the hole in the press plate. But instead of having the stripper plate a little above the top face of the punch, we have it exactly level and we find that the punchings invariably come away with the outside scrap.

If the punch and die were badly fitted there would be a great amount of burr set up; then I should imagine there would probably be some difficulty in removing the punchings, owing to the burr hanging down between the punch and stripper plate. When there is much burr it is a sure sign that something is wrong. Perhaps the tools have been badly fitted or they need grinding, or perhaps an unskilled hand has been employed in setting the tools in the press. There generally is a very slight burr on all work, no matter how well the tools are fitted, and there is also sure to be some slight inaccuracy, but very little indeed if a subpress is used.

It is a well-known fact that the majority of presses rarely give two strokes exactly alike, the slides being fitted so free in the press body as not to hinder the action of the clutch. The neglect of the points mentioned above, together with this slide variation, is all against the securing of satisfactory results. The setting of the tools should be most carefully watched, as the damage that can be done in a very short time by neglecting this point one would hardly credit. As everyone knows who has had anything to do with them, press tools are not the cheapest and simplest things in the world to make, and satisfactory results can only be obtained by watching every point most carefully. Our leading hand, who has had thirteen years' experience on this class of work, tells me that he has never experienced any difficulty in removing the punchings when the directions given above have been carried out. CHERRY RED.

Sheffield, England.

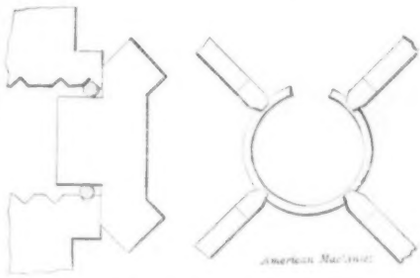
Chucking Irregular Gears.

Editor American Machinist:

Some time ago I had a lot of small gray-iron bevel gears given me to "true up," drill and ream. The truing up was time consuming and very exasperating, for the boss or hub of the gear by which it was held in the chuck was always more or less at an angle to the plane of the gear; but in the following way I greatly reduced the chucking time and eased the strain on my temper.

I made an open ring out of some heavy steel spring wire to go loosely over the gear hub. I placed this ring in the independent chuck in such a manner that it rested in one of the sets of grooves in the jaws with the gap between two of the jaws.

With this device the back of the gear



CHUCKING IRREGULAR GEARS.

can be brought up flat against the jaws despite the angularity of the boss, and the fillet. The gear is easily chucked or removed without displacing the ring.

APPRENTICE.

[A similar method will protect the threads from injury when it is necessary to chuck bolts by the threaded end.—Ed.]

Inventions and Patents.

Editor American Machinist:

Some firms require all draftsmen and others in responsible positions to sign, before entering their employ, an agreement to make over to the firm all inventions they may make without additional recompense. When business is dull and work scarce they have little difficulty in hiring men under these conditions.

When the firm pays liberally and the agreement relates only to the inventions pertaining to the line of machinery the firm makes a specialty of, there is no particular objection to such an arrangement and it is sometimes to a man's advantage. When a concern expects everything and is willing to pay only from twelve to eighteen dollars per week, allowing no vacations and deducting for all legal holidays, this is another matter.

The majority of inventions that a draftsman makes consist of improvements in machines that already exist or in attachments to adapt the machine to a wider range of work. Such inventions are practically valueless in themselves, altho taken in connection with other patents they may be very valuable. If the inventor should privately attempt to make use of such inventions, he would run up against all kinds of difficulties; first, there would be interference, real and pretended, with other patents; second, to successfully work out an idea to a practical use often requires a great amount of experimental work which is very expensive.

Sometimes inventions come by lucky thought or accident, but it has been my experience that they more often come after long, careful study and repeated failures. I was once fortunate enough to work as

assistant to a mechanical expert and inventor, a man who certainly understood his business and who was probably receiving as many dollars per hour for his services as I was per day for mine. I once heard him remark that he averaged about one really important invention a year. One failure followed another with sickening regularity, but when he did finally get a thing perfected it was worth something.

At another time I worked for such a firm as I have mentioned in the first part of this article. I was perfectly willing to make over to them any invention I might get up, as they had a monopoly on the class of machinery they were building and I lacked the capital and influence to make any other use of them. I also felt that to make myself as valuable as possible, altho I might get no immediate return, would strengthen my hold on them and I would be less liable to be laid off during hard times and it might in time lead to advancement.

I was considerably younger then and was foolish enough to think, as did some of my fellow-workmen, that it would be an advantage to have my name go thru the Patent Office as the inventor of certain things. It was the custom of the manager of this concern, whenever any of us thought out something new and carried it to him for his permission to try it, to pull it all to pieces and make all manner of criticisms. We would be advised to put four arms in a gear instead of five, to make this lever a sixteenth thicker, to bend one part to the left instead of to the right, to use a larger or smaller size wire for a spring and to paint the whole thing red instead of black. When the patent was taken out it was his invention instead of ours, or at best we could only get our name on as co-inventor with him.

I was always filled with unholy glee when it was impossible to make the thing work in any other way than that which I had first schemed out. Sometimes, after a complete failure, he would suggest about the only way possible to make the thing work and I would then be able to produce a dated sketch showing that that was my original idea. He never appeared to like this, but would say nothing and walk off.

One day while this subject was being discussed, one of the older men said, "I believe that if I were to take part in a concert in the town hall and should sing a song and the audience should applaud me, that if Mr. X. was in the hall he would rise and make a bow."

It seems to me that if men were allowed to take out patents in their own names it would in no way detract from the glory of the manager and would be a great encouragement to the men and an incentive for them to exert themselves to the utmost the next time something difficult came up. Of course there will be some men who will get the swelled head, think the firm cannot get along without them, and immediately demand more pay whenever they get up any little thing. In such case they could generally be replaced by others just as good and perhaps better; on the other hand, if a man's invention is of real value to a firm, he should receive some compensation for it. ALLEN.

Tables of English-Metric Equivalents.

Editor American Machinist:

The enclosed tables of metric equivalents of English weights and measures and *vice versa* are in a form which I find very convenient, as they read both ways. Thus, reading from line 3 to column 8 of Table 1, we find that one yard is equal to .914402 meter, and, reading from line 8 to column 3, we find that 1 meter is equal to 1.09361 yards. The lower figures in each block are the logarithms of those above them.

ROBERT GRIMSHAW.

Hannover, Germany.

English and American Apprenticeship Practice.

Editor American Machinist:

The remarks of Mr. Thos. Wathey, at page 1441, on systems of apprenticeship in iron foundries might well be applied to all branches of the mechanical trades. Different shops have different systems, some of these highly beneficial to the apprentices, and others the reverse. Few shops have hard and fast lines to follow in going thru an apprenticeship, as a great deal depends on the apprentice or the amount of pull he has. Where the dependence is upon pull the foreman or leading hand can only give the apprentice the opportunity and leave it to his nature and habit as to whether he will take advantage of the opportunity or not.

When serving my apprenticeship in the old country I had a good insight into the pull and premium systems, and know they meet with but indifferent success as far as the apprentice is concerned. I saw young men of every nationality sent by

UNIT	IN.	FT.	YD.	ROD	FURL.	MILE	CM.	METER	KM.	UNIT
IN.	1	0.083 $\bar{2}.92082$	0.027 $\bar{2}.44370$	0.005051 $\bar{3}.70338$	—	—	2.54 0.40483	0.0254 $\bar{2}.40483$	—	IN.
FT.	12 1.07918	1	0.3 $\bar{1}.52288$	0.06 $\bar{2}.78252$	0.0015 $\bar{3}.18046$	0.0001893 $\bar{4}.27737$	30.48 1.48402	0.3048 $\bar{1}.48402$	—	FT.
YD.	36 1.55630	3. 0.47712	1	0.18 $\bar{1}.25964$	0.0045 $\bar{3}.65758$	0.0005681 $\bar{4}.75449$	91.4402 1.96114	0.914402 $\bar{1}.96114$	0.0009144 $\bar{4}.96114$	YD.
ROD	194 2.28780	16.5 1.21748	5.5 0.74036	1	0.025 $\bar{2}.39794$	0.003125 $\bar{3}.49485$	—	5.029 0.70148	0.005029 $\bar{3}.70148$	ROD
FURL.	7920 3.89873	660 2.81954	220 2.34242	40 1.60206	1	0.125 $\bar{1}.09691$	—	201.17 2.30356	0.20117 $\bar{1}.30356$	FURL.
MILE	63360 4.80182	5280 3.72263	1760 3.24551	320 2.50515	8 0.903090	1	—	1609.35 3.20665	1.60935 0.20665	MILE
CM.	0.3937 $\bar{1}.59517$	0.0308 $\bar{2}.51598$	0.01093 $\bar{2}.03862$	0.001988 $\bar{3}.29850$	—	—	1	0.01 2.00000	—	CM.
METER	39.37 1.59517	3.28083 0.51598	1.09361 0.03886	0.19884 $\bar{1}.29850$	0.00497 $\bar{3}.69644$	0.0006214 $\bar{4}.79335$	100 2.00000	1	0.001 $\bar{3}.00000$	METER
KM.	0.001 $\bar{3}.00000$	3280.83 3.51598	1093.61 3.03886	198.84 2.29850	4.97096 0.69644	0.62137 $\bar{1}.79335$	100000. 5.00000	1000 3.00000	1	KM.

American Machinist

TABLE 1. ENGLISH-METRIC AND METRIC-ENGLISH EQUIVALENTS OF UNITS OF LENGTH.

various governments and companies to study the shipbuilding and engineering crafts, with a view to putting the knowledge they might acquire to practical use on the completion of the five years' course. To give them their dues, I must say that fully a half of them were in dead earnest, working steadily all day, no job too hard or dirty, picking up their knowledge of engineering as they picked up their English, a little at a time. In the evenings they would hurry home to their "diggins," not at all ashamed of their dirty serges, have a wash and a change, then off to the technical schools for a good two hours' study.

As to the other half—well, what was to be expected of lads reared in the lap of luxury, used to leading an indolent life, and whose only reason for coming to the shipyards was a desire to be clear of the guardianship of doting parents? In the works you see a strange mixture of all classes; as Kipling says: "Duke's son, cook's son, son of the millionaire"; but who is it we find getting the best work allotted to apprentices? The cook's son. It stands to reason that the apprentice who has money to burn and is only killing time, who is liable to disappear every other sunny afternoon or to go off on a three-day fishing expedition occasionally, is not going to get a job to work on where a deal of care and attention is necessary. But as to the lad who is serving his time to actually learn the trade, who is scrambling along somehow on his few shillings a week and overtime, and can't afford to lose a minute, the more intricate the job the prouder he feels and the steadier he works.

In one yard where I worked a fine specimen of the "time-killer" occasionally used the vise next to mine. His people owned large iron works, and he was learning the business with a view to one day being manager and eventually owner. As a relaxation from his labors he kept a small racing yacht, with a crew of two men, which he used about two or three days in the month. He had a hunter, too, and followed the hounds occasionally. I cannot remember the answer I gave him when he proposed to sell me the yacht "dirt cheap," as it was the end of the season. I wondered then if any young fellow had so much loose cash around, and I wonder now how his works are getting along under his guiding hand. The last I heard of him he was some sort of superintendent and was costing the firm more than he was worth with his theories and blunders.

So much for the man with a pull. The system followed where I served my apprenticeship was to give the apprentice his choice of either "fitting" or "turning." Fitting included all sorts of bench work and floor work; turning included all lathe, planer, and machine work. If not satisfied with the branch he had chosen, an apprentice could change over before the end of his second year, but no changes were allowed after that. As we built all sorts of machinery, the works were divided into seven or eight shops, each having its own foreman and assistant foreman. The result was that at the completion of his apprenticeship a lad was either a good vise hand or a good lathe hand. Each branch of the trade stands distinct in the old country, and a man applying for a job as a fitter rarely applies for a turning job if no fitters are required, and *vice versa*.

After having been sailing out of the States for some years, I thought I'd like to tackle a shore job, but I found to my dismay that in nearly every case a knowledge of the lathe was essential. I also found that every machinist who had served an apprenticeship could work at either the vise or the lathe, and had a good, all-round knowledge of machine construction.

A great deal more could be said of the comparative merits of the systems of apprenticeship, but from the experience I have had of machinists, afloat and ashore, I consider that the man who served his time in the old country at the vise or at the lathe has a more substantial and wider range of knowledge in his own particular branch than his colleague on this side of the water. The "all-round" system in vogue here, tho, is much the better of the two if a man doesn't intend handling the tools all his life.

X. Y. Z.

UNIT	GRAIN	GRAM	OZ. AV.	LB. AV.	KILOG	SHORT CWT.	TON			UNIT
							SHORT	METRIC	LONG	
GRAIN	1	0.0647989 $\overline{2}.81157$	0.0022855 $\overline{3}.35898$	0.00014286 $\overline{4}.15492$	0.000064799 $\overline{5}.81157$	—	—	—	—	GRAIN
GRAM	15.43234 *1.18843*	1	0.035274 $\overline{2}.54744$	0.0022046 $\overline{3}.34329$	0.001 $\overline{3}.00000$	—	—	—	—	GRAM
OZ. AV.	437.5 *2.64098*	28.3496 *1.45255*	1	0.0625 $\overline{2}.79588$	0.0283495 $\overline{2}.45241$	—	—	—	—	OZ. AV.
LB. AV.	7000 *3.84510*	453.593 *2.65667*	16. *1.20412*	1	0.453595 $\overline{1}.65667$	0.01 $\overline{2}.00000$	0.0005 $\overline{4}.69897$	0.0004536 $\overline{4}.65667$	0.0004464 $\overline{4}.64972$	LB. AV.
KILOG	15432.34 *4.18843*	1000. *3.00000*	35.27392 *1.54744*	2.20462 *0.34333*	1	0.0220462 $\overline{2}.34333$	0.00110231 $\overline{3}.04230$	0.001 $\overline{3}.00000$	0.0009842l $\overline{4}.99308$	KILOG
SHORT CWT.	—	—	—	100 *2.00000*	45.3593 *1.65667*	1	0.05 $\overline{2}.69897$	0.045359 $\overline{2}.65667$	0.0446429 $\overline{2}.64975$	SHORT CWT.
SHORT TON	—	—	—	2000 *3.30103*	907.186 *2.95770*	20. *1.30103*	1	0.907186 $\overline{1}.95970$	0.8928571 $\overline{1}.95078$	SHORT TON
METRIC TON	—	—	—	2204.62 *3.34333*	1000 *3.00000*	22.0462 *1.34333*	1.10231 *0.04230*	1	0.984206 $\overline{1}.99309$	METRIC TON
LONG TON	—	—	—	2240 *3.35025*	1016.05 *3.00691*	22.4 *1.35025*	1.12 *0.04922*	1.01605 *0.00691*	1	LONG TON

American Machinist

TABLE 2. ENGLISH-METRIC AND METRIC-ENGLISH EQUIVALENTS OF UNITS OF WEIGHT.

Machining Collars for Shafting.

Editor American Machinist:

At page 1413 Frank B. Kleinhans describes a collar-making job and, altho he states that they must be true, it would seem impossible to make them so by the method shown.

After boring the hole he faces the side,

rough and finish at one cut. They are next held in a universal chuck and the other side faced, rough and finish, at the same time. He now has the hole reamed, and the sides *nicely* finished and *parallel*.

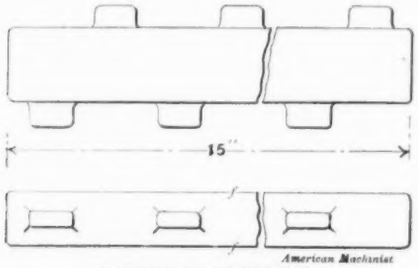
To turn the outside he strings twelve collars on a screw arbor, drives with a dog on the nut, and turns these twelve in various degrees of truth, from pretty near at the ends to out pretty bad at the middle.

I should like to ask who makes those paper washers? Are they made in a machine shop? Any man who has cut paper washers with his pocketknife, to pack out a gang of mills, will say no. THEODORE.

Planing with the Magnetic Chuck.

Editor American Machinist:

"Scotty's" letter on page 1334, entitled "Surface Grinding and the Magnetic Chuck" recalls to my mind a planing job which was successfully accomplished by



CASTING TO BE PLANED.

means of the magnetic chuck. Several hundred gray-iron castings 15 inches long, similar to the sketch, were to be planed to .629 inch thick with the allowance of .001 inch. These pieces were first milled on both sides to .655, then strapped to the planer table, two at a time, papered up for the first cut, and then strapped to the table, planed side down, and finished. The results obtained were poor. The pieces would not come parallel or within the limit, tho the best workmen were put on them. An electric chuck was set up. The castings were then taken, papered up and planed on one side. The planed side was then laid on the chuck and the second side finished. The results obtained were excellent, the finished castings being parallel and exactly to size. W. T. M.

Rubber Stamps in the Drawing Room.

Editor American Machinist:

A great many times a draftsman could use a rubber stamp in his work if it were not for the fact that the ordinary stamp does not leave a line heavy enough to make a good, clear blueprint from, but leaves a faint mark which, if not looked for very closely, could easily be overlooked. A very satisfactory and also quick way to overcome this trouble is to use your stamp and while the ink is still wet take an ordinary writing pen and with plenty of ink (regular drawing ink) run over the stamped letters or figures quickly. You will find that the wet stamp ink will readily be followed by the other ink, and thus you will have a stamp mark in just as good condition as the rest of your drawing. H. D. REMSEN.

Stippling Drawings.

Editor American Machinist:

An article on spatter work at page 1170 and the comments on it at page 1345 are of interest to me because they are in line with a process which I have used for more than twenty years for indicating stonework on my tracings. I pour a few drops of drawing ink into a saucer and by thoroughly smearing a round bristle brush about ⅜ inch in diameter in this ink I imitate the foundation, not by spattering but by *stippling* with the end of the brush. By using considerable ink on the brush and not much on the tracing an effect is produced which considerably resembles stonework. It looks well and, what is more to the point, it prints well. To keep the stippling within proper limits, one of our men devised an adjustable shield. This

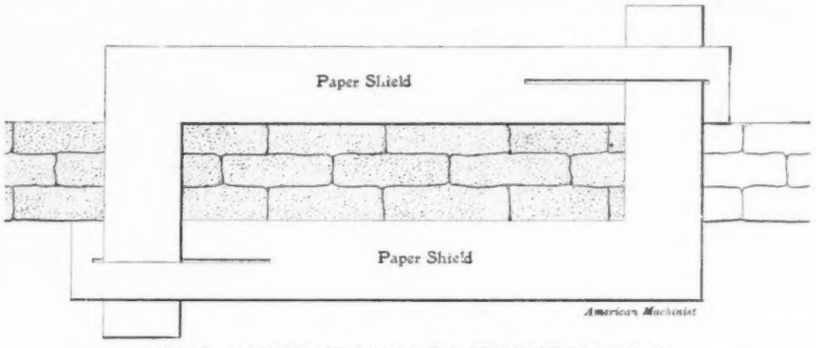


FIG. 1. ADJUSTABLE SHIELD FOR STIPPLING DRAWINGS.

consists of two pieces of heavy paper in the shape of a letter *L* with a slot cut in one leg of each piece thru which the other leg is inserted. This makes the shield adjustable in all directions, as shown in the cut Fig. 1. If made out of thin sheet brass or copper, it can be cleaned by washing and will last for years.

In writing for catalogs it is an old-fashioned notion of mine to enclose stamps for postage. It is not safe to enclose these stamps loosely in the letter because they will probably fall out unnoticed when the letter is opened. If the stamp is stuck on to the letter even by one corner it is not an appetizing thing to use over again by the usual process of moistening it on the tongue. (Better moisten the envelope and attach the dry stamp to it.) But for sending stamps, the best way which I have found is to cut two parallel slots in one corner of the letter and insert the stamp thru these as shown in Fig. 2. The friction of the paper will be sufficient to hold the stamp in place and at the same time it can easily be removed and will then be as good as new. W. H. S.

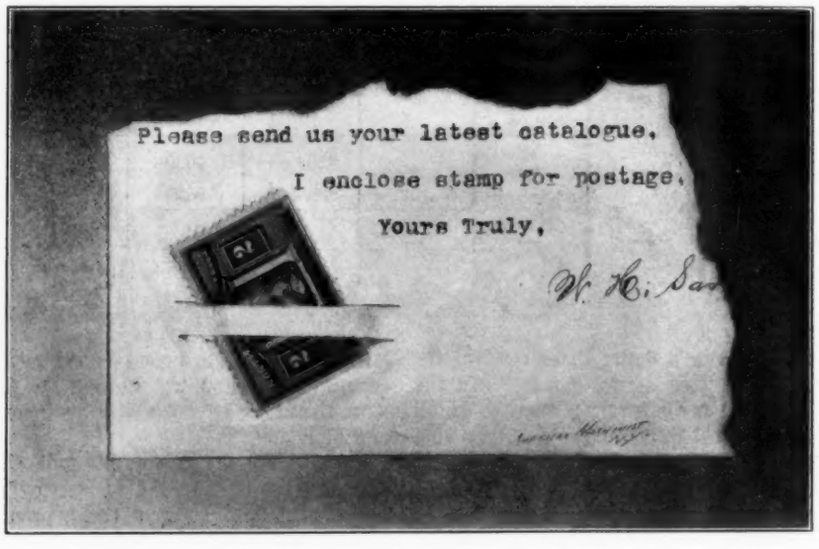


FIG. 2. "I ENCLOSE STAMP FOR POSTAGE."

A Practical Apprenticeship System.

Editor American Machinist:

The management of apprentices has occupied much space in your columns, and justly so, as the apprentices are to supply the skilled workmen, and without men of the highest skill in our shops America must in time take a back seat.

Much theorizing has been done as to why boys of the better class do not learn trades. I believe that the principal trouble is that the job of the apprentice is made too irksome, and that not enough attention is paid to his welfare and advancement.

After considerable experience with apprentices, I have adopted a system which is giving good results.

I personally examine all applicants and keep the names of those who appear to be desirable. I select the boys on their merits, and not because they happen to have a rich or influential uncle, an aunt or a friend at court. As soon as I need a boy, I take the first one on the list and put him at work sweeping, cleaning castings, running errands and making himself generally useful, so that he may be getting acquainted with the shop. If he does well, he is required to sign the following contract:

I, ..., in consideration of being taught the trade of ....., do agree to serve the ..... faithfully and to the best of my ability for the term of four years, and agree to accept the following wages per hour as payment in full for my services: The four years to be divided into periods of six months each. For the first period, 7½ cents; second, 8 cents; third, 9 cents; fourth, 10 cents; fifth, 11 cents; sixth, 12 cents; seventh, 13 cents; eighth, 14 cents.

I further agree to work the hours that the shop may be running, and to expect no extra pay for overtime, except such as shall be in excess of ten hours per day, which overtime shall be paid for at the rate of time and a half. In case I am required to work on Sundays, Christmas, Decoration Day, July 4th, Labor Day or Thanksgiving Day, the rate of pay shall be for double time.

I further agree to abstain from liquor in any and all forms as a beverage and from cigarettes, and that my habits shall be such during the four years that I shall be in good physical condition to perform my duties.

In case I should be absent more than one week, holidays excepted, in any term of six months, I agree to make up such time before entering upon the next term; and if I am off less than a week, for a term of six months, I may begin the term that much sooner.

We, ..., in consideration of ..... serving us faithfully for the term of four years, do agree to teach him the trade of ....., subject to his agreement which forms a part of this contract, and the following provisions:

For the first three months he is to be considered on trial, and if we find him unfit for such trade, or indifferent to his duties, he shall be corrected, and if he does not then improve, he shall be notified that his services are no longer required. He shall accept cheerfully at all times such work as shall be given him, and try to get it out in good time and shape. He shall have every opportunity which our shop affords to learn said trade thoroughly, and he shall be instructed by the foreman and competent workmen in all branches of the trade.

He shall be entitled, during each period of his apprenticeship, with the exception of the first and second periods, to four half-days, with pay and carfare, in which he shall visit and inspect such shops as we shall designate.

In case he shall violate his agreement or absent himself without just cause from his work, or become indifferent and careless in his work, we reserve the right, after correcting him and trying to get him to do better, to dispense with his services.

After having faithfully served his term of four years, he shall be entitled to a bonus of one hundred dollars ($100) and to a certificate, signed by the secretary of the company, stating in full his experience and ability.

Signed in duplicate this..... day of .....

.....

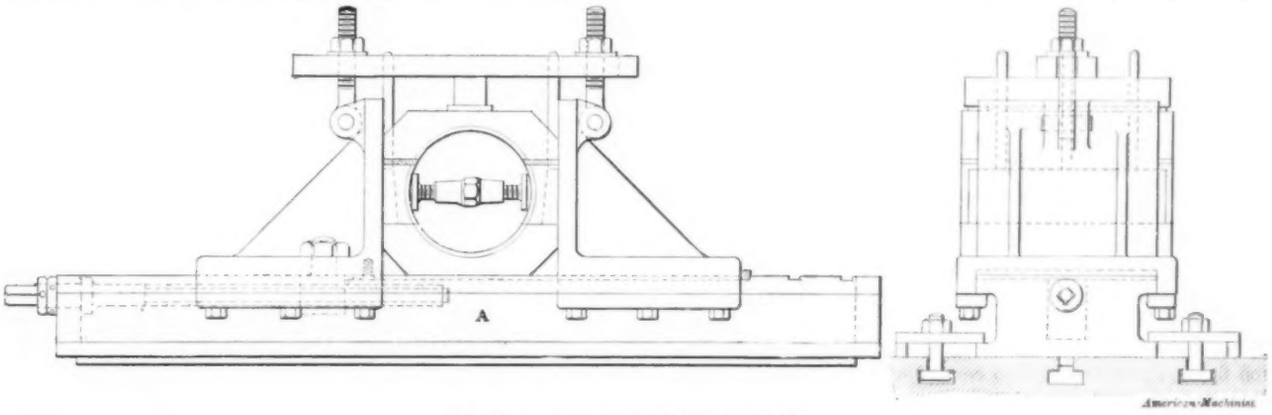
.....

After roughing it for about six months he serves about six months as tool and stock boy in the tool room and from there goes into the shop on a lathe, and from there to milling machine, shaper, planer, drill press, vise, etc., as opportunity offers. We do considerable outside work, and as soon as a boy is competent, I send him out with a journeyman, to repair engines, set up small plants, etc. I keep in close touch with all the boys and let them understand that their chances depend entirely on their own exertions.

There is one point about our contracts which I think is original, and which seems to attract the boys and spur them on more than anything else we can do for them. I refer to the provision for allowing them to visit other shops at our expense. The shop routine gets monotonous to almost any vigorous boy and he is liable to get discontented and not take the interest he should; but when he is sent to some other shop he takes it as a holiday and makes the most of it, and will come back to work with renewed energy and with new ideas of how work should be done. Another good feature is that he will frequently see also how work should *not* be done and will thus profit by the mistakes of others. The various superintendents around here have been very courteous and have afforded the boys every opportunity to gain ideas. We send our pattern shop apprentices to foundries as often as to pattern shops.

We are getting a class of bright, ambitious boys, and I believe that our plan is well worth the serious consideration of any who have the same problems to solve.

Moline, Ill. W. P. HUNT.



BORING FIXTURE WITH WORK IN PLACE.

Boring Fixture for Compressor Bearings.

Editor American Machinist:

The shop management had considerable trouble with the shaft bearings (such as are used in Corliss-frame air compressors) not coming square, and so we made a fixture as per sketch for holding the work while boring. *A* is a gray-iron casting made sufficiently strong to withstand heavy strains, and machined to receive two heavy, firmly gibbed jaws, also made of gray iron, and so fitted as to be moved where desired upon base *A*. The jaw nearest the horizontal boring machine operator is controlled by means of a square thread screw of ample size and a brass nut, while the other jaw is slid to the point desired and stopped by a key dropped into one of the slots cut across the top of the guide. The fixture is shown with a bearing chucked and ready for the babbitt to be bored. We use a right-and-left-hand jack to hold the sides of the bearing back to the take-up wedges and in proper position until the binding clamp at the top of the fixture is adjusted, when the jack is removed. As will

be noticed, we use swing bolts on this as on many of our fixtures. We find this beats chasing around the shop looking for bolts. BECK.

The Draftsman as a Planner of Work—Molding Worm Gearing.

Editor American Machinist:

I was once told by the chief engineer of a prominent manufacturing concern that his company considered the drafting room a "necessary evil." I suppose this is because it is "non-producing." From my own observation, while certainly a non-producer, it is in many cases a cost reducer, the producer of methods (tools, jigs and fixtures make methods) which lessen the cost of production. The trouble is that in most cases these methods are carried only as far as the machine shop.

A designer or draftsman should understand the foundry as well as the machine shop. He should know how a piece will come out of the sand best, where to and where not to use cores. He should be able to decide after consultation with the foremen of pattern shop and foundry the best methods to be used in certain cases. The draftsman often designs a piece of machinery so that it will come within the capacity of certain tools in the machine shop, often making a piece in two pieces where one would do, so that it can then be more easily handled and machined without in any way impairing its efficiency. The pattern shop and not the drafting room is the designer in the case of foundry work. Patterns cost just as much as machine-shop fixtures and should also come under the design of the draftsman. I don't say that the drafting room shall, in every-day straight work, say how a piece shall be molded, but there are many cases where the judgment of the drafting room should show that special patterns, core boxes or fixtures would pay.

I will, for example, describe the molding of a worm and a worm gear and the tools and methods adopted as designed in a drafting room. The worm was phosphor bronze, 8½ inches diameter and 1¼ inches pitch, quadruple threaded, and the worm gear of gray iron about 4 feet diameter. It was a job of which the yearly output was quite large. The worm and gear were not required to be cut and machined, but the job called for a better class of work than a foundry can turn out without special pattern and fixtures. The ordinary method of molding a worm like this is to place it horizontally in the flask, half in the nowel and half in the cope. This has the objection that the worm produced is not round, that the cope can shift and that there are always fins to remove. In making the core for the worm gear the ordinary practise is to make it in segments. By this method there is always a chance of getting the spaces between the teeth which come at the joint either too large or too small.

The entire worm *A*, Fig. 1, was put on a match board to locate it and keep it vertical, and it then was rammed up in the nowel. The cope was then p t on and rammed up and lifted off, the only part of the pattern in the cope being the boss and core-print. The fixture *D*, a four-legged spider or yoke, with its screw *C* and nut was slipped on the pins of the nowel, the set-screw *B* was tightened and the pattern *A* unscrewed from the sand, the screw *C* having of course the same lead as the worm, and the pattern was thus supported until clear of the sand. The gate was cut in the cope, the core put in place and the mold closed up and gated.

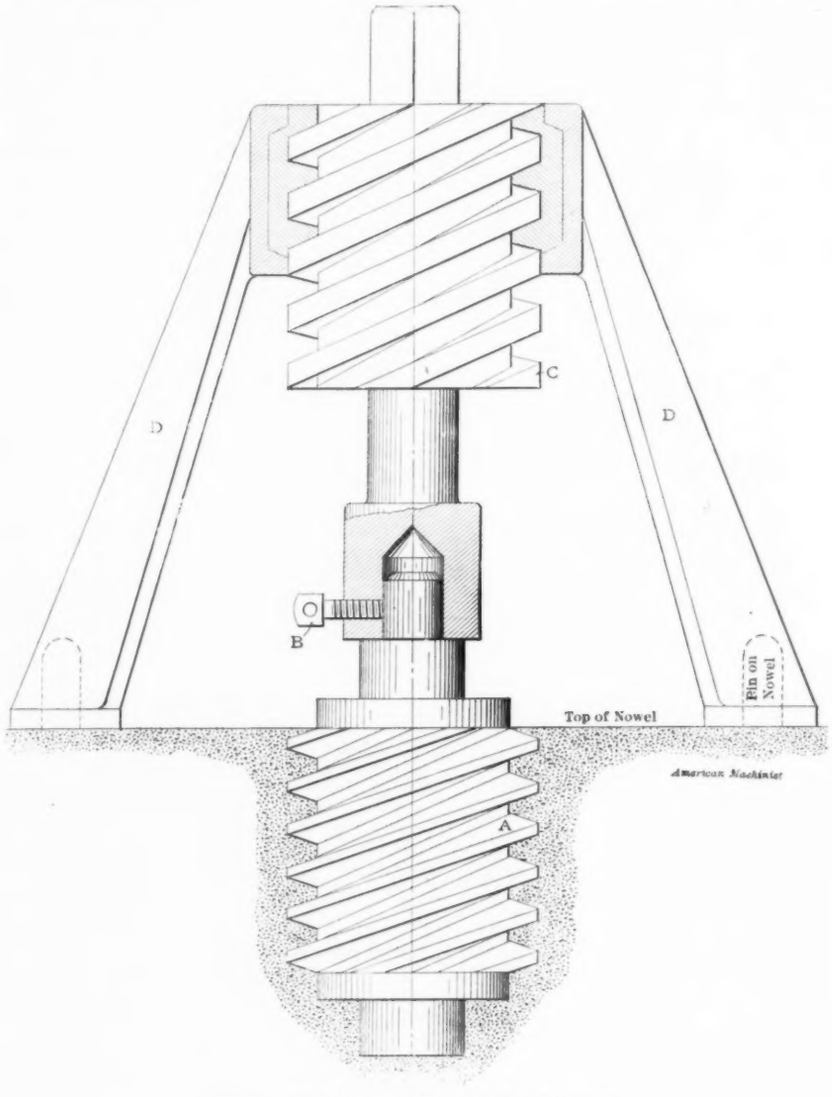


FIG. 1. RIG FOR DRAWING A WORM PATTERN.

If the core for the worm gear could be made in one piece it would obviate the trouble which a core made in segments makes. The core for this wheel, which looked like an internal gear, was made as follows: The teeth *D*, Fig. 2, were cast on a worm which was of such dimensions as would give the teeth the proper clearance. Two parallel pin-holes were drilled in the base of each tooth before removing from the worm. The pin *E* is first inserted in the center of the core box *F*, the plate *L* is dropped into place, the segment *G* is slipped over the pin *E* and the teeth *I* are put in place and located by the pins *N*. This section is then rammed up and the top of the core is cleaned up by the sweep *K*. The pins *N* are then withdrawn and the segment is moved to the position indicated by the dotted lines, the pins are re-inserted in the teeth at *J'*, the other teeth *I* are then moved to position *I'* and pinned and the core is rammed up. This operation is repeated until the core is complete, with the exception of, say, a space equal to six teeth and spaces. This is so that the segment *G* can lap the gap and have teeth on both sides of the gap in the part of the core made up, which on the starting side would be the teeth at *J*.

The cap is rammed up and the core is complete with its core rod *P* in place. Hooks to handle the core should be fastened to this core rod. The pin *E* is now withdrawn, the segment is removed and the core, supported by the plate *L*, is hoisted out by means of the three eyes *M* spaced 120 degrees apart. The additional cost of making the patterns in this way, together

with twelve plates *L*, is less than the cost of cutting twelve worms and gears.

HERMAN JONSON.

The "Colorado."

Editor American Machinist:

I went over to the drydock at the Brooklyn Navy Yard to have a look at our new cruiser, the "Colorado." The drydocks on the Delaware are too small for her, and so the government drydock has been requisitioned so that her bottom may be sleek and offer as little resistance as possible on her trial trip.

Her hull of course does not interest me as much as her engines do, but it and the upper works have a nice, clean-cut appearance. It is evident that there have been gigantic strides in shipbuilding since I

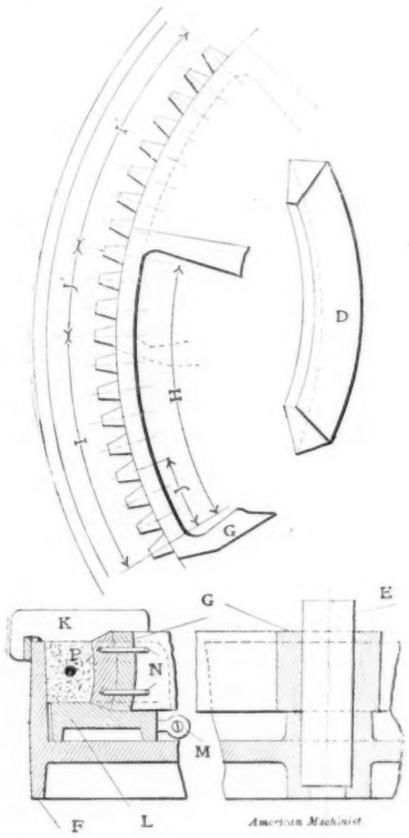


FIG. 2. MOLDING A WORM-WHEEL.

worked on the cruiser "New York" at Cramp's in 1902. After groping around and getting into wrong alleyways, etc., I eventually found my way to the "tops"—I mean the engine tops, and not the fighting variety.

There is considerable difference between the "tops" of a merchantman and a man-of-war. On the man-of-war no polished flanges of cylinder heads greet the eye, merely a long, box-shaped room with a grated floor. This grating is composed of steel plates about 1 inch thick by 12 inches deep, laid on edge in pockets in long bearer bars. They can be removed readily in case repairs are necessary on the cylinders.

This grating is supposed to be shellproof. I think I would prefer to risk being hit or having my engines hit by one shell at a time than have the tons of steel that compose this grating come thundering down into the engine-room. The plates used in this protective grating are apparently considerably stronger than their supports.

The space below is very cramped. The head room on the bottom plate is not over 5 feet 9 inches. The engines are quadruple and are as fine engines as I have seen anywhere. The turning gear (for turning the engines when overhauling them) instead of being placed just abaft the after crank or forward of the thrust block, is in the center of the crankshaft—*i. e.*, between the two forward and two after cranks. The reversing gear is a direct-acting ram. All the pipes in the engine-room are covered with non-conducting composition; but underneath the cylinders have been left bare, which will probably make it very uncomfortable in case of emergency repairs on the crossheads with steam up.

The trip round to New York was entirely satisfactory. Not a hot bearing, not a drop of water used on any of the bearings, and the men on watch in the engine-room say the ventilation was perfect. The engines turned up 120 revolutions per minute under natural draft, and at that speed indicated 24,200 horse-power. Forced draft was tried for about two hours. During her official trial the engines will be required to make at least 129 revolutions.

Passing from the engine-rooms into the stokeholds, one is struck by the cleanliness of everything, and altho there was steam up it was almost as cool as on deck. There are thirty-two Niclausse boilers. Working pressure is 300 pounds. Each boiler has a single furnace and each furnace has three doors.

The feeding of the boilers is automatically regulated by means of a float arrangement. I was assured by the engineer on watch in the stokehold that they were entirely satisfactory so far, and that the feed had not been touched by hand for forty-eight hours.

The feeding is done by Blake pumps, of which there are eight—four main, connected with the condenser, and four auxiliary, which may at will be connected with the condenser, the reserve feed tanks, or the sea. There is a very good arrangement for obtaining the density of the boilers. For the benefit of those who do not know how this is usually (supposed to be) done, I will tell the how and why. No matter how carefully a job may be run, salt water is bound to get into the boilers. Even with fresh water for extra feed there is always slight leakage at the condenser, etc., and the amount of salt in the boilers gradually increases and the water becomes denser. With denser water more coal is required, and when the water becomes very dense the salt separates from the water and is deposited on the tubes and plates with possible disastrous results. To obtain the density of the water, a salinometer pot, a salinometer and sometimes a thermometer are used. The salinometer pot is a copper pot about 3 inches in diameter by about 12 inches deep. A salinometer is merely a common hydrometer made of brass instead of glass. It is graduated so many ounces of salt or solid matter to the gallon. The salinometer pot is held under the salinometer cock, which is situated below the water level of the boiler. This cock is generally out of repair and squirts streams of hot water of various calibers all over the engineer, showing generally a decided disinclination to fill the pot and a preference for the engineer's engine-room slippers. To this latter little eccentricity on the part of the salinometer cock is due the other method of taking density—*i. e.*, add a little to the density marked on the log sheet of the watch preceding your own. After the salinometer pot is full, the salinometer is dropped in and the reading is taken. The reading is supposed to be at a little below the boiling point, but with this method no one can really know what it is.

On the "Colorado" the salinometer pots are fastened to the bulkhead and connected with the water in the boiler by means of a pipe. They contain a thermometer and an overflow. The salinometer is put in the pot, the water is turned on, and when the water reaches the desired temperature the density is taken.

There is a good device for shutting the stop-valves on the boilers on the starboard side, from the stokeholds on the port side, and *vice versa*. In case of accident this is a very valuable precaution.

The stokeholds and engine-rooms are all provided with water-tight bulkheads and doors which may be shut from either side. There is a fine evaporating plant and electric plant. All the winches and hoisting gear are electrical.

The "Colorado" does the Cramps great credit.

DIXIE.

A Flexible Ruler.

Editor American Machinist:

At page 1438 F. W. Burger shows a very good flexible ruler which, while new to me, reminds me of an arrangement I used years ago when in the bicycle business. I think it was about 1896, when there was a craze for queer handle bars which went by the name of "ram's horn." I had a lot of appliances for producing these idiotic things. Each rider had (or thought he had) his own particular form which suited his requirements. Nine out of ten could not either give a sketch or the amount of spread, drop or curve. It was then I made a handle bar of lead tubing which I bent to suit their requirements. After the lead bar was bent to shape it was an easy matter to bend the steel bar *nearly* the same. The lead bar was then bent exactly like the steel bar, and when the customer came for his bar, if he made any kick about the shape, the lead templet with his tag on it

was brought down from the shop and compared with the steel one, and that settled it. DIXIE.

Oven Truck and Core Bench.

Editor American Machinist:

The combined truck and core bench shown in the drawing was designed for use in a coreroom with a level and smooth concrete floor. In this room are two rotary ovens for small cores, and one 8x12-foot-square oven, all using oil fuel.

The combined truck and bench is used by the coremakers as a bench on which the cores too large for the rotary ovens are made, and when the truck is full it is run into the oven. A sufficient number of these trucks are supplied to twice fill the oven, thus allowing four to be in the oven and four on the floor being used as benches. The sketches are, I think, so clear as to require but little explanation. The truck has three wheels all running on roller bearings. The front wheel is set in a housing which has on the upper end a flange running in a ball-bearing case. The flat plate forming the top or bench is planed and is perforated with 2-inch holes, as shown. This is to make it lighter and to allow the heat to circulate. A removable bail or handle hooks into the two eyes in front, and with this a truck is easily moved from place to place by a man or boy. The few dimensions given will indicate the scale of the drawing. The table or bench is about 56x30 inches, and the hight above the floor 31 inches. Any dimensions may of course be changed to suit other conditions. B. W. T.

For Free Alcohol.

Attention is very properly being called to the Boutell Free Alcohol Bill now before Congress. This bill provides that alcohol for use in manufacturing and the industrial arts shall be free of tax when suitably "denaturized" or made undrinkable by mixture with noxious substances. Not many perhaps realize the full bearing and importance of this bill in regard to many, and less directly to most, of our industries.

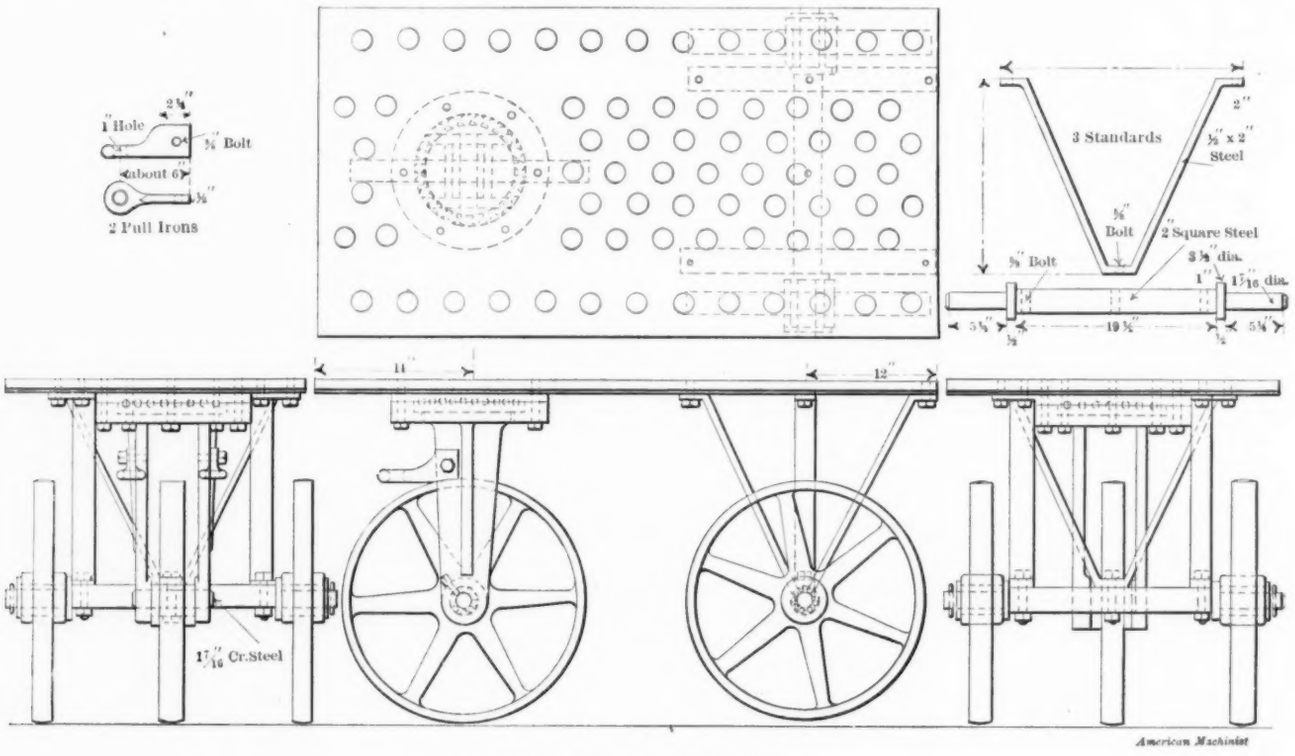
In all the leading commercial nations of the world, except the United States, a distinction is made between distilled spirits intended for beverage consumption and alcohol intended for industrial purposes. While the former is invariably taxed, and often very heavily, it is established as a sound principle of government that alcohol intended for industrial purposes should be made as cheap as possible, and all European nations have laws permitting the use of alcohol free of tax when denaturized according to officially prescribed processes. In Germany (our principal rival, next to England, for the world's trade) the laws governing the industrial uses of alcohol are particularly effective.

In the United States no distinction is made between alcohol used for industrial purposes and distilled spirits intended for beverage consumption. For purposes of taxation they are both classed as distilled spirits, and subjected to a tax of $1.10 on the proof gallon of 50 per cent. alcohol. This is the normal strength of alcoholic beverages. The strength of commercial alcohol is 94 per cent., and as this is 1.88 times the strength of the proof gallon, the tax on it is nearly $2.07 per gallon.

Alcohol is easily and cheaply produced, the government chemists of the Department of Agriculture reporting that under present conditions alcohol testing 94 per cent. could, if not taxed, be sold profitably for about 15 cents per gallon, and other authorities have asserted that under a large demand and favorable conditions it would be profitable to sell it for 10 cents per gallon.

The industrial uses of alcohol are large and widely extended, and in all countries where it is tax-free, and therefore cheap, it is used to an enormous extent, and employment for hundreds of thousands of workmen is found in ways not possible in this country, where an internal revenue tax of $2.07 per gallon practically prohibits the use of grain alcohol in all but a few industries.

Alcohol is a better fuel for the automobile and internal combustion engines than gasoline. It is a better fuel for domestic cooking and heating than either coal or gasoline. As an illuminant when used with the incandescent mantle it rivals the electric light and is superior to kerosene. Alcohol is necessary in the manufacture of more than a thousand different articles, and is a heavy item of expense in the manufacture of varnishes, lacquers, gilding and bronzing. It is a solvent for the stiffening of felt hats and straw goods, and the box toes of fine shoes. In the manufacture of the best smokeless powder 1¼ pounds of alcohol are consumed in making one pound of powder, and the tax on the alcohol more than doubles the manufacturing cost of



OVEN TRUCK AND CORE BENCH.

the powder. In the manufacture of celluloid large quantities of alcohol must be used, and it is the same with the manufacture of photographic films and paper, of fulminating powder and many other materials. In the manufacture of the various colors for silk, cotton and woolen goods, wall paper, printer's inks, etc., it is one of the most important and costly of the necessary raw materials, and in dyeing it is a valuable agent in fixing the colors. There is scarcely a manufacturer in the country who does not use alcohol, a solvent derived from alcohol or an inferior substitute, to a greater or less extent, in the production of his goods, and aside from manufacturing purposes it has a very wide field as a preservative, and for cleansing, burning, bathing and other domestic purposes.

More than 10,000 factories, representing thirty distinct industries, with an aggregate capital exceeding $500,000,000, and employing 300,000 hands, use alcohol, a solvent derived from alcohol, or an inferior substitute, as a raw material of manufacture. In all these factories the cost of manufacture is greatly increased by the tax on alcohol. In many the cost is more than doubled. The growth of domestic trade is thus greatly hampered, and the development of the foreign trade rendered impossible. The cost of alcohol free of tax would not exceed 15 to 20 cents per gallon. The tax of $2.07 per gallon increases the cost 12 to 15 times.

The removal of this excessive burden of taxation would result in an enormous expansion of both the domestic and export trade in all the alcohol-using industries. The extent of this increase it is of course impossible to estimate. In the aggregate it would certainly provide employment for at least 60,000 additional workmen in the alcohol-using industries already established and in addition to this tax-free alcohol would result in the re-establishment of those industries which have been destroyed or driven to foreign countries by the excessive tax and the creation of thousands of new factories, thus providing employment for many more.

In addition to the above the great increase in the use of alcohol as an illuminant, as fuel for cooking and heating, and for the internal combustion engines, which would follow the removal of the tax, would result in a widespread demand for special lamp apparatus, stoves and internal combustion engines of all kinds. The alcohol incandescent lamps would be in demand on the farms and in the rural districts in every section of the country, and to supply this demand the lamp manufacturers would have to employ additional help, and would be rushed with orders for years to come. It would be the same with stove manufacturers. The 1900 census report states that there were 1,414 factories with 20,000 employees in these two industries. Thus in these two industries alone the employment of thousands of additional workmen would be certain.

It has been estimated that alcohol fuel available for use free of tax would double the power uses of this country. With free alcohol no region would be remote from a cheap fuel supply, and wherever production is now delayed or hampered on account of dear fuel, free alcohol will set mechanics at work and the wheels of industry turning. In all parts of the country productive processes will be cheapened, opening up employment for thousands of additional hands.

The effect of free alcohol in opening up the vast arid regions of the great West for settlement must also be considered, as the ultimate increase in wealth and population from such settlement may overshadow all other possibilities combined. The irrigation of these lands, thus making them among the richest and most productive in the world, is largely a question of cheap power, and alcohol will furnish this in unlimited abundance. The alcohol engine would water the ground on which the material for the distillation of its own fuel would be produced. These lands are capable of supporting millions of people.

A Pacific coast engine manufacturer has pointed out that the alcohol engine is the ideal engine for irrigating purposes, and supplies data to show that in California alone the demand for this purpose would not be less than 30,000 engines, and California is only a small part of the territory to be served. In the manufacture of these engines, and in their sale and distribution, many thousands of men would be employed, and the number who would find homes on the reclaimed lands, and those in turn who would be employed to manufacture the articles for their consumption, and attend to their commercial necessities, would run into the hundreds of thousands.

A national expenditure of one hundred million dollars would be a small price to pay to secure such possibilities, but instead of it costing the government anything to free industrial alcohol from taxation, *it would result in an increase in the revenues.* It is a matter of dispute among experts whether there would be any falling off in the revenues from distilled spirits even; many contending that the increased consumption of tax-paid spirits that would necessarily be a part of such industrial development would more than offset any losses from either tax-reduction or shifting of industrial consumption to the free list. Assuming, however, that there might be some slight loss in the revenues from alcohol, this loss would be more than offset by the increased use of other articles subject to internal revenue tax, and the increase in customs revenues.

The most important service that can be rendered to labor by Congress is the enactment of legislation which will result in the opening up of new opportunities for employment, and the extension of existing industries. This will be accomplished by removing the tax from alcohol used for industrial purposes, thus conferring a great and permanent benefit on the wage-earners and business interests of the entire country.

The Lewis and Clark Centennial Exposition.

An event of considerable interest to the nation at large for the ensuing year, and of surpassing interest to the dwellers on the Pacific coast, will be the Lewis and Clark Centennial Exposition to be held at Portland, Ore., from June 1 to October 15. Tho following so closely the St. Louis Exposition it will cater to an entirely different personnel of visitors, and exhibitors will appeal to a new, a large and an enterprising community. The circular of the exposition says, probably with considerable truth, that the population of the Pacific coast is more eager to see and to buy, and has more money to buy with, than that of any other portion of the United States. The plans for the exposition have been made upon a liberal scale. The total cost is estimated at $5,000,000. The United States Government has appropriated $450,000 for its special exhibit; the Legislature of the State has appropriated $500,000, and the citizens of Portland have subscribed and paid in $500,000. Large and massive buildings are planned, and all the instructive and attractive features which the later expositions have developed will be provided and brought up to date. The published preliminary view of the entire exhibition is perhaps the most picturesque and attractive ever devised. The grounds will embrace 407 acres, including a beautiful natural lake. Three snow-clad peaks and the Cascade range of mountains look down upon the whole. Applications for space and conditions or for any information should be addressed to Henry E. Dosch, director of exhibits, Oregon State Building, St. Louis Exposition.

Some Common Misconceptions.

A mass of aluminum weighs one pound; a mass of lead of equal size weighs something more than four pounds. The English physicist will say that aluminum is *more than four times lighter* than lead. Weight, heaviness, is an attribute of matter, lightness is absence, or deficiency, of weight. To say that one article is a certain number of times *lighter than* another is like saying of two vessels unequally exhausted of air that one is four times emptier than another.—*Nature.*

It might be added that it is equally erroneous to say that one body or substance is colder than another. There is no such thing as cold. There are only varying degrees of heat, and we commonly regard as cold those things that are below 98 degrees Fahr., or, below the temperature of the human body. But a substance that is at the freezing temperature is quite hot compared with liquid air, and liquid air boils violently when in a vessel placed upon a cake of ice.

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Contents.

	PAGE
Molding a Flywheel with Wrought-Iron Spokes	1493
Alcohol for Motors—IV	1494
Boring, Facing and Milling Machine for Small Compound Cylinders	1497
Aluminum Iron Molds for Brass Castings	1497
A Worm Driven Auxiliary Table for a 16 by 24 Niles Boring Mill	1498
Over-Systemizing	1499
Things That Are Usually Wrong—I.	1500
The Great Engineer of the Subway	1500
Differences in Hoisting Capacity	1501
Gas Flasher	1501
Shrinkage Troubles and Methods of Feeding	1502
Sherardizing Iron and Steel	1503
Notes on Cranes	1504
About "Lloyd's"	1505
Letters from Practical Men	1506-1516
For Free Alcohol	1516
The Lewis and Clark Centennial Exposition	1517
Some Common Misconceptions	1517
Apprenticeship	1518
Inventions by Employees—The Inventor's Oath	1518
The Lack of Engineer Officers for the Navy	1518
Some New Things	1519
Some Russian Visitors	1522
Technical Publications	1522
The Story of a Gun Barrel	1522
The Failure of a Technical Graduate	1523
Personal	1523
Obituary	1523

Apprenticeship.

We commend to the attention of our readers the letter in another column of this issue describing an apprenticeship plan. Apprenticeship is by no means so dead in this country as many would have us believe. There are very many large and prominent shops that still take them, and it is our belief that in nearly every case where the matter is handled intelligently it is found to be advantageous to take them and to give them thorough training. Mr. Hunt, the writer of the letter referred to, owns a small shop, but if there were no evidence bearing upon the case other than his letter, we should expect to find his shop permeated with ideas and to find things accomplished by the work of brains, rather than by brute force. The plan of specifying a certain number of half days during each six months' period to be spent by the boys in visiting other shops is, it seems to us, especially commendable, and the provision by which a premium is put upon steady work—the avoidance of lost time—is unusual, if not entirely novel, and certainly has much to commend it.

It is our belief that the trade of a machinist and the other trades concerned in the building of machinery cannot be properly taught except by a good and thorough system of apprenticeship; that if there is to continue to be a supply of good and competent workmen, they must be trained in a systematic manner after careful selection.

In our issue of December 24, 1896, we published a very full account of the status of apprenticeship as it then existed in the trades connected with machine construction. We had addressed letters to 200 of the most prominent machinery building establishments and railroad systems of the country asking for their practise regarding apprentices and their views upon the question of apprenticeship. We received 116 replies, practically all of which were published in some form, and showed that out of the 116 replying 85, or something over 73 per cent., were taking apprentices and that nearly all of these expressed themselves as being satisfied in varying degrees with their experience with it. Several widely accepted theories with regard to apprenticeship were shown by the letters published to be entirely erroneous, among them the generally accepted theory that trades unions, and the opposition of foreigners controlling them, were responsible for the decline of the apprentice system. It was shown that most all of those who did not take apprentices declined to do so because they considered them to be non-paying—a bother or an interference with the regular and steady progress of manufacturing processes.

Of course there may be conditions under which apprentices would not be of advantage to the establishment employing them, and usually where this is the case apprenticeship in such an establishment would be of no advantage to the boys. But in most cases we believe that where some thought is given to the matter and it is handled with care and with some appreciation of the fact that boys are not machines and that it is a case of dealing with human nature, the system can be made to work with entire satisfaction to both parties. To merely hire boys and put them into the shop to take their chances is a very poor way of doing; to handle the matter intelligently is necessary, and when so handled we believe it can almost always be made a success.

Inventions by Employees—The Inventor's Oath.

In another column we publish a communication on the subject of inventions and patents in which our contributor states the practise of some shops and the attitude of men employed as designers and draftsmen toward it. It is in fact a vexed question which is looked at from entirely different standpoints by the different persons who have to do with it. The tendency among employers is to think that where men are employed by them in any capacity whatever, and they are led by such employment to devise improvements upon machines made in a works, such improvements or patents belong to the employer. The law, however, is not so, but on the contrary declares that unless there is a special agreement to the contrary, all such inventions belong to the inventor; tho there is a modification of this absolute ownership where the experiments have been conducted in the establishment of, and the material of experimentation supplied by, the employer.

There is a phase of this subject which is often overlooked and which we think it would be well to give some attention to; and that is, that where, as in the case cited by our correspondent, an invention is developed within the works and the proprietor takes the inventor's oath, without having really invented the machine or improvement, such patent can be annulled by anyone who happens to know and be able to prove the facts in the case. The law does not contemplate that anyone other than the inventor can apply directly for a patent; the only course contemplated by the law is that the real inventor shall apply for the patent, tho he may, if he chooses, assign such patent to another party. It is not lawful for a man to himself take oath that he has invented a thing which has not really been invented by him but by an employee, and in every case where it can be proven that such false oath has been taken the patent can be annulled by anyone to whose interest it is to annul it. This is a point which is carefully looked after by a few manufacturers, but we believe is overlooked by very many others who ought to give attention to it.

The Lack of Engineer Officers for the Navy.

The annual report of Rear-Admiral C. W. Rae, Chief of the Bureau of Steam Engineering, just made public, contains

nothing more interesting, nor perhaps more important, than the account therein given of the engineering personnel of the Navy. It seems—and somebody should have thought of it before—that if we keep on building ships of war, as we are likely to do, we will need more men and especially more engineers to make them operatively effective. The story told of the supply of naval engineers for even present needs is, from some points of view, a rather pitiful one. The suggestion which is made in the report to put ships out of commission so that there may be enough engineer officers for those remaining in commission is certainly a striking way of stating an apparently desperate case.

The report states that there are only 66 "engineer officers" in the Navy; 8 captains, 14 commanders and 44 lieutenant-commanders, and under the law only the lieutenant-commanders are eligible for sea duty, the others having positions in navy yards, in the various bureaus, etc. This list will be still further decreased, as within a year 8 officers will be retired and 7 of the lietutenant-commanders will be promoted, leaving only 37 instead of 44, and, besides this, only one-half of these are expected to be at sea at the same time. More than one-half of these are now in active service, there being 11 battleships, 13 cruisers and 4 other ships each with an engineer on board. There are 62 other ships in commission, exclusive of torpedo boats, and these are in charge of young line officers or warrant machinists. Admiral Rae very pertinently and properly says: "A modern navy without an efficient engineering personnel is deficient in one of its prime requisites and will fail in the hour of battle. The present condition of engineering in the navy is a cause of grave anxiety to all conversant with the subject."

It possibly is not as bad as suggested. We strongly suspect that many of the "young line officers" can show gray hairs, and no doubt the warrant machinists know all that is required concerning the operation and maintenance of the responsible mechanisms with which they have to do, so that it is quite probable that if any one of the unfortunate 62 vessels were called upon in a sudden emergency it would not fail to give a good account of itself by reason of the absence of an "engineer officer."

We are not at all disposed to belittle the requirements of the Navy as stated by those most completely informed concerning them. We are quite aware that strict discipline must be maintained, that the minutest details of wisely planned systems must be carried out, and that for the maintenance of morale in the demoralizing days of monotonous peace something more is required than narrowly technical engineering skill and judgment, and that for those things especially "engineer officers" are most necessary. As to securing and retaining them in qualifications and in numbers up to the demands of the service, why is it not entirely a matter of inducement? It is only to make the positions worth while, not only for the pecuniary considerations, but for the social and professional status and the probability of reasonably rapid rise in rank, upon merit and not upon pull, and it should no longer be an unsolved problem to secure and hold our quota of "engineer officers."

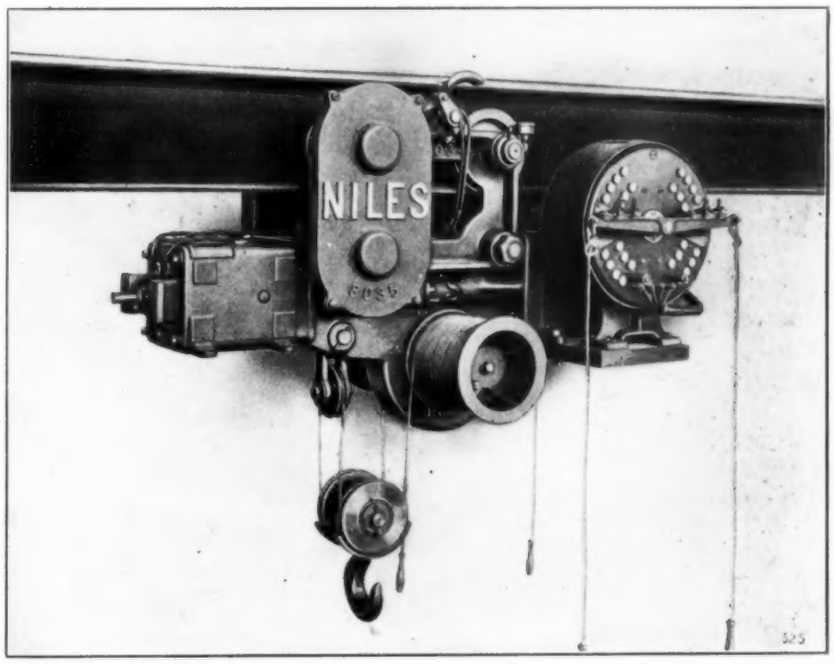
We have recently had something to say about the reforming of the British patent laws, and in connection with that we might add that we would be glad to see our American Patent Office reform the style in which the printed copies of the patents are issued, and copy the British practise. The inconvenience of reading or studying an American patent on account of the constant referring back and forth from drawing to text and from one drawing to another, with never both text and drawing visible at once, is sufficiently and more than sufficiently familiar. In all British patents the drawings are placed at the back, and they each have a blank at the left as large as the printed page, the drawing folding in upon it. The drawing when unfolded lies out at the right of the text and both are entirely visible at once and can be studied and compared in comfort. It is much the better way, and should be adopted by the United States Patent Office.

At a woodworking factory at Goffstown, N. H., a partridge—plump, of course, as they always are—recently flew in at the door of the factory, smashing the glass in the engine-room door, then between the spokes of the flywheel, and after these feats alighted on the top of a cupboard where it was captured.

Some New Things.

ELECTRIC TRAVELING HOIST.

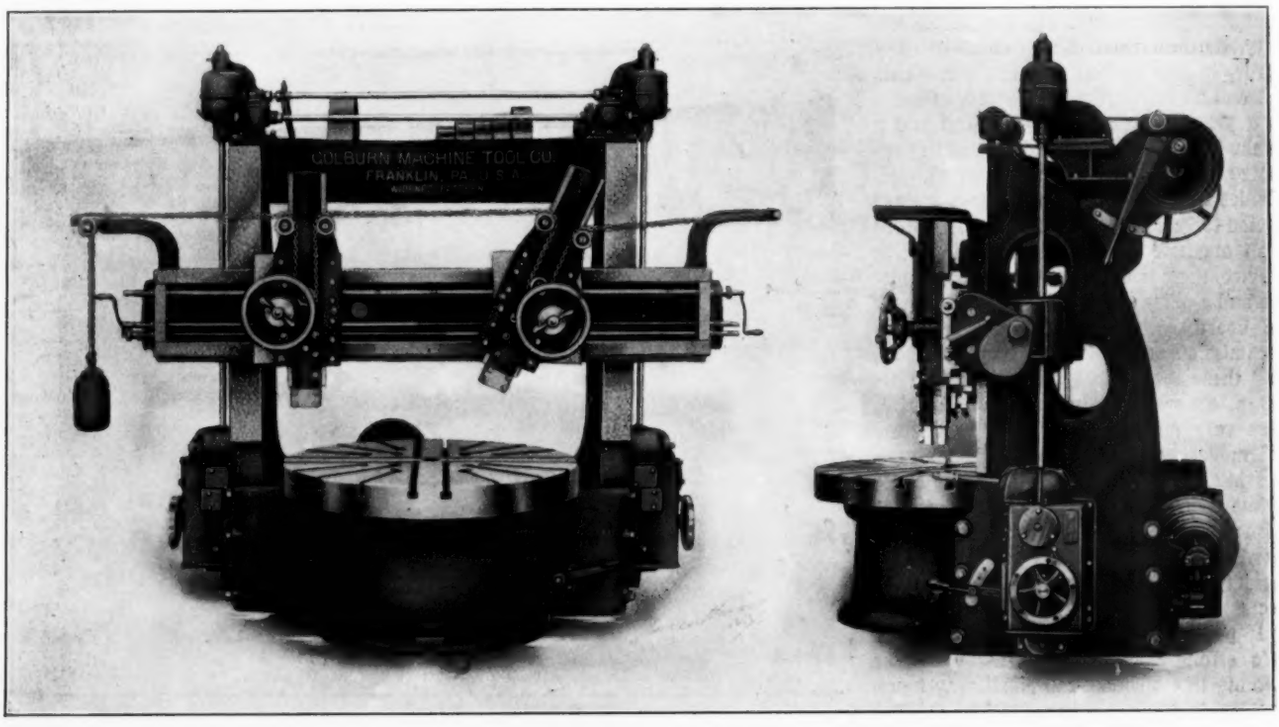
The illustration shows an electric hoist which is built in capacities of ¾ ton to 6 tons and may be run on an I-beam track, or mounted on a traveling bridge and used as a light crane. In the latter case, it is arranged to run between the two I-beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge and operated by cords from the floor, or in an operator's cage attached to the bridge. When used on an I-beam, the controllers are attached to the hoist and operated by cords from the floor. The hoist will run on straight and curved tracks and is usually provided with a separate motor for traversing, but if desired, hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The hoist is self-contained, the motors being attached end on to the heavy gray-iron frame, and the power is transmitted directly from the armature shaft to the drum shaft thru a worm and worm-wheel train. The traversing mechanism is driven thru a train similar to that for the hoisting mechanism, except that when the trolley is arranged to run on a single I-beam, a double set of transmission gears is used to connect the worm gear shaft to the truck wheel shafts. The mechanism is enclosed in oil and dust-proof casings and is noiseless in operation. In addition to the braking effect obtained by the use of the worm and worm-wheel, a powerful electric brake is attached to the hoisting motor. This hoist is built at the Niles works of the Niles-Bement-Pond Company, New York.



ELECTRIC TRAVELING HOIST.

A WIDENED BORING MILL.

The Colburn Machine Tool Company, of Franklin, Pa., has recently brought out a 72-inch boring mill which is built from the regular patterns for its 60-inch mill, widened out to make a machine that has an actual swing of 74 inches, this necessitating merely the widening of the bed casting and the substitution of a new cross-rail and top brace. The cone pulleys also are made with a wider face for a 4-inch belt; otherwise the mill is similar to the regular 60-inch size, and was designed for use in shops having an occasional large piece to turn and bore but not enough to warrant them investing in a heavy 72-inch mill, and for other shops which have to machine work of large diameter but of comparatively light character, such as gray-iron gas-engine wheels, pulleys, gears, etc., and similar work not requiring a rapid reduction machine. For such work the mill is well adapted, as it is heavy enough to use high-speed steels to good advantage on gray iron, tho not intended for rapid turning on such work as steel tires for locomotive drivers, etc. The widening principle has been applied to planers for some time and has proven to be a good thing. The conditions as applied to a boring mill are of course quite similar.



A WIDENED BORING MILL.

There are ten changes of speed for the main spindle and table of this machine, arranged in geometrical progression. The main driving mechanism is contained in a separate head placed compactly between the housings at the rear, and in case it ever becomes necessary to take the machine apart, the entire driving head can be removed by loosening the bolts which hold it in position. The cone pulleys are of generous proportions and the whole driving mechanism is amply powerful, the main drive for the table being a spur gear and pinion. As will be noticed, gears and bearings are protected by suitable guards and ample provision is made for oiling all running parts.

The heads are entirely independent in their movements and can be set to any angle each side of the center. There are ten positive gear-driven feeds for each head, ranging, per turn of table, from .025 to .500 inch horizontally and from .020 to .400 inch vertically. The feed boxes are conveniently placed at each side of the machine. By giving the hand-wheel one turn five changes of feed are obtained, and by the multiplying lever in front the gear ratio is altered so that five more changes are obtained by turning the hand-wheel a second time, making in all ten changes, which are in geometrical progression. The other hand lever near the top of the feed box is for reversing the feed or for stopping it. All the feed changes can be made when the mill is running at any speed.

The machine is provided with a friction brake, which is operated by a foot lever placed within easy reach of the operator at the front of the bed. The friction is applied to the inside of the lower driving pulley by means of a taper cone, and by operating directly upon the driver all shock and jar is eliminated and the table brought to a dead stop in any desired position.

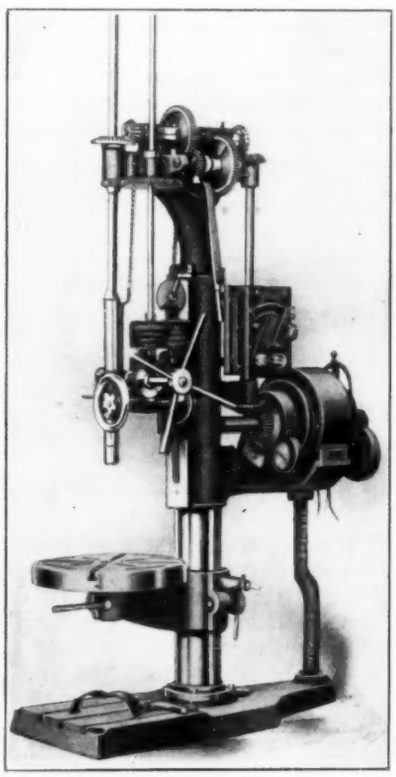
A thread-cutting attachment is made for this mill, which can be applied at any time to the right- or left-hand head, and will cut from 4 to 13 (including 11½) threads per inch. The illustrations show the mill equipped with a power quick-return attachment for the heads and rams; this attachment, however, can be left off if desired. The handle shown prominently on the top of the feed-gear case operates both the quick-return and the feed, and the mechanism is so constructed as to make it impossible to engage both at the same time. The mode of operation is very simple. When the handle referred to is in its normal horizontal position the word "Locked" shows uppermost. A quarter turn to the right engages the feed clutch and locks the power return, and then the word "Feed" shows uppermost upon the handle. A quarter turn toward the left from normal position engages the power quick-return, at the same time locking the feed, and the word "Return" shows uppermost upon the handle. The quick-return is driven from the jack-shaft by a roller chain to the upper shaft shown in the front view and running across from housing to housing. Upon either end of this shaft is a bevel pinion meshing into a pair of bevel gears which are loose upon the vertical shaft. These gears have a cup cone that receives a male cone secured to the vertical shaft and the latter is raised or lowered by the handle at the top of the feed-gear case, according to the direction it is desired to return the head or ram. The vertical shaft is nicely counterbalanced so that little effort is required to raise or lower it, and the whole mechanism is entirely enclosed by guards, as shown.

As noted above, the machine swings full 74 inches; the maximum distance under cross-rail is 47 inches; the table diameter is 58 inches; the length of the cross-rail

is 9 feet 6 inches, and the travel of the rams 26 inches. The machine occupies a floor space 12 feet by 7 feet 10 inches, and weighs 22,500 pounds.

MOTOR-DRIVEN DRILL PRESS.

The Aurora Tool Works, Aurora, Ind., has placed on the market a 24-inch drill arranged with a 2 horse-power Cushman variable speed, single wire system motor. The accompanying half-tone shows the arrangement of the same. It is attached to the column of the drill and drives the top shaft by a vertical shaft geared to the motor, with miter gears. The top shaft is geared 5½ to 1, giving about 40 changes in the spindle speed and from about 12 to 500 revolutions per minute. The arrangement does away with all belts, cone and tight and loose pulleys. It is also equipped



MOTOR-DRIVEN DRILL PRESS.

with positive self-feed with four changes. The changes of feed are arranged by a spring key in the cone of gears. All changes of speed and feed can be made while the drill is in motion and without change of position of the operator. The motor as arranged reduces the floor space occupied by the drill as made without the motor about 8 inches by dispensing with the tight and loose pulleys.

A NEW FRICTION CLUTCH.

The accompanying illustrations show a friction clutch having some new features. The shoes *F F* are expanded by the toggles *J J*, but these toggles are not actuated directly by the operating lever. Links *K K* connect the toggles with the levers *L L* which are fulcrumed at *P P* on the sliding sleeve *M* and have their outer ends connected by springs *S*. In the operative position, shown in Fig. 1, the springs obviously act to expand the shoes, but by withdrawing the sleeve as in Fig. 2 the toggles and shoes are withdrawn. The force with which the clutch drives is thus not determined by the minute adjustment of the toggles, but by the adjustment of the springs and, similarly, when the clutch is engaged it is not by the force exerted by the operating lever but by that exerted by the springs. It will be observed from

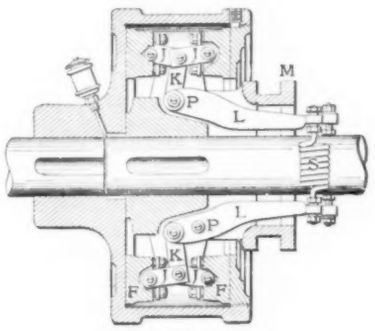


FIG. 1

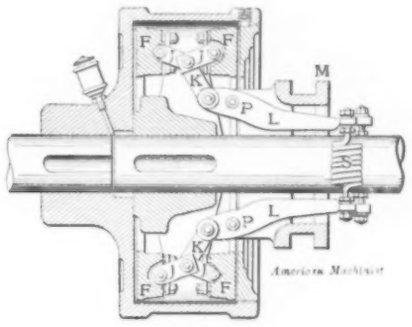


FIG. 2

A NEW FRICTION CLUTCH.

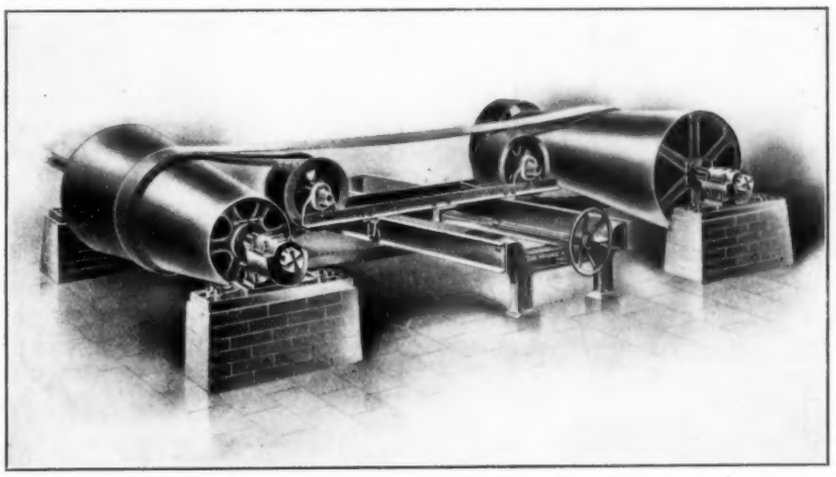
Fig. 1 that the toggles are not thrown past their centers in order to lock the clutch in the operative position, that function being performed by throwing the links *K* beyond their centers.

In use the springs are adjusted until the clutch will transmit slightly more than the power necessary to drive the machine to which it is attached and, when engaging the clutch, the operating lever is thrown abruptly, the slipping of the shoes under the spring pressure acting to pick up the load gradually. The size of the clutch need therefore be only that which will transmit slightly more than the effort necessary to drive its load and need not be proportioned for a heavy starting effort due to abrupt engagement. The case of the clutch is oil tight and a supply of oil is placed within it to provide flooded lubrication. The supply is such that, with the clutch at rest, it shall not overflow, while, with the clutch in motion, the oil is distributed about the circumference by centrifugal force.

The clutches are made in sizes having a capacity of from 1½ to 1,000 horse-power (measured at 100 revolutions per minute) by the H. W. Caldwell & Son Company, of Seventeenth street and Western avenue, Chicago, Ill.

VARIABLE-SPEED COUNTERSHAFT.

The half-tone shows a variable-speed drive as constructed for the operation of paper machinery, but which in lighter form is also made for overhead use in driving machine tools, etc. The mechanism comprises, as represented, two cones upon which are operated two short belts or "transformers" of leather which are beveled internally to suit the taper of the cone and provided with crowned faces to carry the driving belt in exactly the same manner as would two crowned pulleys. The idlers for carrying and shifting the "transformers" are mounted at opposite ends of a frame which is shifted by hand-wheel and screw. Provision is made for maintaining proper tension for the driving belt and any kind of belt not wider than the "transformer" may be used. The Moore & White Company, Philadelphia, Pa., is the maker.



VARIABLE-SPEED DRIVE FOR PAPER MACHINE.

POWER PUNCH PRESS.

The illustrations show a power punch press built by the Cincinnati Punch and Shear Company, Cincinnati, Ohio. The position of the brass cam shown in Fig. 2 is adjustable so that the machine may be made to stop either at top or bottom of

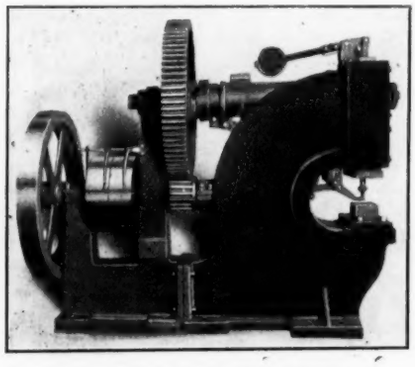


FIG. 1. POWER PUNCH PRESS.

stroke or at any intermediate point. The hole thru the clutch and that part of the shaft upon which it slides are square, the usual key being dispensed wit.

A LIGHT AND HANDY SOCKET WRENCH.

The wrench here shown is not a Yankee product, but it is one that a Yankee need not have been ashamed of. It is a wrench which comes in the equipment of a French automobile and is a marvel of lightness and handiness. It is a steel tube throughout and has simply been swaged and formed to the required shape. The ends are, of course, of different sizes, and for

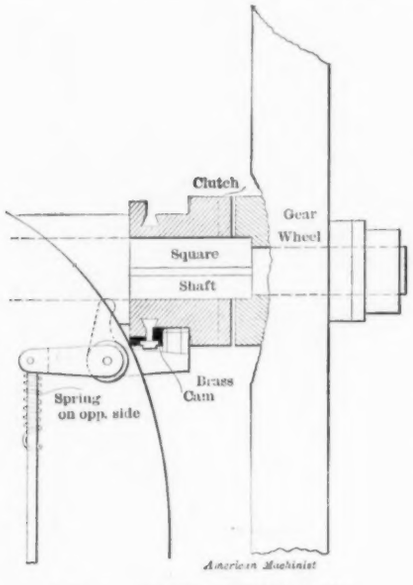


FIG. 2. CLUTCH ARRANGEMENT.

one end the wrench itself constitutes a sufficient lever. When the other end is used a pin is inserted in the cross holes of the body, the positions of the holes permitting very small angular movements. The wrench would seem to offer a suggestion to some of our manufacturers.

Some Russian Visitors.

Mr. I. A. Semenoff, a manufacturer of cigarette-making and other automatic machinery in St. Petersburg, Russia, is visiting this country, accompanied by his technical director, Mr. K. I. Jouravleff. In their works in St. Petersburg they use a good deal of American machinery and are at present looking for more to be installed in an addition of new departments to the works to be devoted to new lines, including machine tools and wood-working machinery. They hope to make arrangements with some American builders of such machinery by which co-operation will be secured and under which they will receive drawings, patterns, etc., and also information of improvements that may be made here from time to time. During a conversation with Mr. Jouravleff, we were strongly impressed with his thorough knowledge of the best and latest American shop practise. The names of our leading tool builders are household words with him and he declared his intention of consulting with Dodge & Day, Taylor, Gantt and Barth, with a view to installing the very latest and best systems of shop management. Speaking of this journal, he said it had imparted a new life to their establishment, and it is evident they are making full and intelligent use of it. The business was founded about fifteen years ago; they use the metric system exclusively and are in every way pleased with it.

Technical Publications.

"Alternating Current Engineering." By E. B. Raymond.

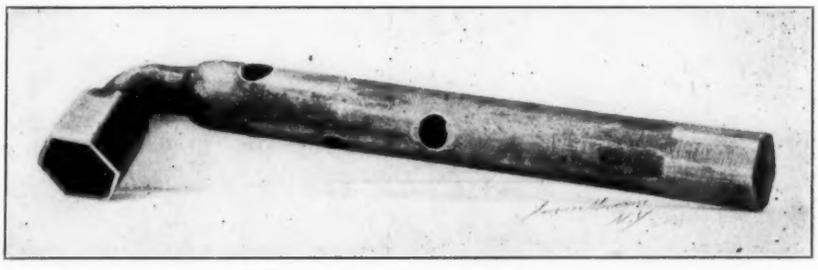
We regret to say that the price of this book given as $2.00, at page 1450, is erroneous. The figures should have been $2.50.

"Reinforced Concrete." By A. W. Buel and C. S. Hill. 434 6x9-inch pages, with 311 illustrations. The Engineering News Publishing Company, New York. Price, $5.00.

The growth of the use of reinforced concrete both in this country and in Europe is one of the most significant and important movements now in progress in building and engineering construction and the present volume is correspondingly timely. It is divided into three parts, of which the first relates to the methods of calculating the dimensions of structures, the second gives representative examples of structures that have been erected, and the third describes the methods of construction that have been developed. Part I includes a large number of data relating to experimental tests, together with formulas for beams, columns, retaining walls, dams, arches, etc., and extended tables of safe loads; Part II contains a large collection of details illustrating the more important methods of construction that have been used in a great variety of structures and Part III illustrates with equal fullness a great variety of construction methods. The book will thus be seen to be a representative of the best class of engineering literature and one which cannot fail to be of large usefulness and to have an important influence in accelerating the growth of concrete construction.

The Story of a Gun Barrel.

A woman—Emily Grant Hutchings—has been writing the above named story, and it is printed in a recent number of the publication sent out by the World's



A LIGHT AND HANDY SOCKET WRENCH.

Fair people. From it we abstract as follows:

"To the sportsman, the most fascinating exhibit in that great Belgian national building at the World's Fair is the collection of Heuse-Lemoine gun barrels. And the sportsman is by no means the only one who can find something here to interest him.

"The modern rifle, viewed not as an instrument of death but as a triumph of man's mind over base metal, is a thing to be marveled at. The finest hand-wrought gold is not more beautiful than the gun barrels that are produced in the valley of the Vesdre in Belgium. The surface of these barrels shows the most wonderful tracery, in fine spirals, intricate curves like those produced by the Japanese in the best of their cloisonne, wave effects, like moire silk and the exquisite dot and line pattern of bird's-eye maple. These designs are not put on the surface of the barrel, as the ornament is applied to the exterior of a cloisonne vase. They are merely the result of the fiber of the barrel itself.

"A real Damascus barrel, that is capable of withstanding the severest strain, is a thing of beauty. It is the result of loving and patient toil, and the treatment that gave strength gave beauty as well.

"The display in the big showcase is not

a working exhibit, but it serves the same purpose, for it shows the barrel in every stage of its development. There are bundles of alternating sheets of iron and steel, tied together with fine wires, and these bundles are seen again, welded and drawn out into the form of thin ribbons. The ribbons are twisted into the semblance of cork-screw curls. These curls are then welded and drawn out into other ribbons to be twisted again. At each twist the fiber of the steel is given an added lateral turn, and in the finest Damascus barrels this process is repeated as many as a hundred times. Indeed the barrel is subjected to a heat sufficient for welding one hundred and fifty times before it is finished.

"The cheap gun barrel is composed of alternating strips of iron and steel, welded together lengthwise. The strain on the barrel that results from the explosion of powder is almost entirely lateral. That is why the cheap barrel is likely to burst when the gun is discharged. The Damascus barrel is stronger, not only because the fiber is made to run laterally, but because it is twisted into a perfect network of strength. The iron and steel, that at first were half an inch thick, are drawn out until they are as fine as a hair, and because of the difference in color, every contortion of the metal leaves its mark.

"For some of the barrels the process begins with small blocks of metal instead of the flat plates. These are set together like a checkerboard, iron squares alternating with steel, and are bound together. They are then placed in an oven and heated sufficiently to permit of perfect welding, but not enough to destroy the quality of the steel. The welded checkerboard is drawn out into a ribbon of two-colored metal that is handed over to the expert barrelsmith, who gives it its first twist. The ribbon is white hot when it is being twisted, and the work must be done with geometrical regularity. From two to six of the curls are put together, according to the quality and pattern desired, and are laminated into the form of a ribbon again.

"There is only one kind of iron that may be used for the best quality of Damascus barrels, and that is the hand-made charcoal iron. The desire for cheapening the process of manufacture, that has exerted its baleful influence the world over, has placed an abundance of coke iron on the market, and the more expensive charcoal kind is now so rare that it is exceedingly difficult to obtain. It is superior to all other iron in at least three respects.

"Its color is much lighter than either the Swedish or the ordinary coke iron, so that the resulting contrast between the iron and the steel produces the beautiful tracery in the fiber of the barrel. It may be welded at a much lower temperature than is required for the cheaper iron, so that the quality of the steel is not lost. The third point of superiority is that, while ordinary iron becomes brittle with the successive hammerings, the charcoal iron increases in elasticity. The final stage of the smith's work is the twisting of the barrel itself. The twisted but unwelded barrel is shown in the Belgian exhibit. To the layman it looks like a curled shaving of steel.

"The final ribbon, reduced to exactly the proper thickness, is curled around a mandrel that is covered with a steel jacket or sleeve of the right dimensions. The barrel is then welded together, an inch at a time, until all the joints of the spiral are united. The hammering is done on an anvil that is provided with semi-circular grooves.

"Finally the metal sleeve must be bored out and the exterior must be ground on a fine stone, polished, treated with various kinds of acids and mounted. The finished gun is a thing to be cherished in the cabinet of a connoisseur, for it is absolute perfection in its class."

Now, in order to complete the story, it should be said that modern methods of steel making enable a gun barrel to be made of a single homogeneous piece of steel without a single weld, and that a barrel so made is in every way far superior to the Damascus barrel, except that it does not look so pretty. To the eye of one who knows its superiority, however, it looks better, because it looks more appropriate to the work it has to do. It is stronger to resist internal pressure and harder to resist internal wear and erosion—a better gun barrel in every way—and the only reason sportsmen and others pay a higher price for Damascus barrels than for plain steel ones is because they don't know any better, and because the Damascus barrel has so long been considered "the thing." It would be of little use to go to a modern ordnance officer and propose that he discard his gun barrel steel having a tensile strength of 100,000 to 120,000 pounds per square inch, an elastic limit of 70,000 to 75,000 pounds and 15 to 20 per cent. elongation, and replace it with a laminated mixture of iron and steel of unknown qualities.

The Failure of a Technical Graduate.

We have published a great deal, pro and con, regarding technical education. A new phase of the subject is revealed by the following extract from the *New York Times:*

It must be more than slightly embarrassing for the Faculty of Atlanta's Polytechnic School to note that one of its recent graduates lost his life Tuesday evening at Montgomery, Ala., while attempting a task no more difficult than that of cutting a charged electric wire. The fact that the tragical accident occurred while the young man was on the roof of a bank, to which elevation he had carried, besides the lineman's ordinary implements, a varied assortment of burglars' tools and high explosives, shows that his intention in going there was not one for the carrying out of which a Polytechnic Institute makes even a tacit contract adequately to prepare its students. The Atlanta professors, therefore, would not have been put at all on the defensive if the young man had merely failed as a bank robber. What he did, however, was to fail as an electrician, and not only that, but he failed while engaged in practising a very simple and elementary part of the electrician's art. That does put them on the defensive, and it behooves them, we think, to give the matter serious and prompt attention. We would not go so far as to assert that the young man's sorrowing relatives can place upon the school responsibility for his death; we are sure that they couldn't sue it for damages—successfully; but none the less there is something wrong with the curriculum of that institution or with its methods of instruction. Even bank burglars have some rights, and one of them is that if they go to the trouble and expense of acquiring a scientific education at a technical school, they should be safe from disasters like this.

Personal.

Henry E. Eberhardt, who was identified with Gould & Eberhardt, of Newark, N. J., for more than thirty-five years, as a member of the firm, chief designer and inventor, has resigned from the above company, and is now associated with his sons, in the Eberhardt Brothers Machine Company, of Newark, N. J.

Obituary.

W. Chaplin Bemis, of the Bemis & Call Hardware and Tool Company, Springfield, Mass., died of apoplexy in that city, October 26, seventy-two years old. He was elected treasurer of the Bemis & Call Company upon its organization in 1855 and in 1897 became its president also.

John C. Klein died at Carrick, Pa., October 26, eighty-two years old. Mr. Klein was a native of Prussia and came to this country in 1847. In 1856 he established a tool-making factory, shovels, etc., at Pittsburg—on the "South Side." The business prospered and grew, and in 1868 his brother and another partner were taken in, the firm now being Klein, Logan & Co. Mr. Klein retired three years ago.

Business Items.

The Hopkinson Machine Works, Springfield, Mass., have added a larger vise to their regular line of sizes, jaws 7½ inches long, 2 7-16 inches deep, open 9 inches.

The Keuffel & Esser Company, New York, received two awards at the St. Louis Exposition, a grand prize in Group 19, Liberal Arts, for instruments of precision, philosophical apparatus, etc., and a gold medal in Group 115, Mines and Metallurgy, for instruments and equipment for underground surveying.

The new isolated plant installed in the Twenty-third Regiment Armory, Brooklyn, N. Y., will contain two 75-kilowatt Northern generators, direct connected to Harrisburg engines operating at 275 revolutions per minute. There is also a 35-kilowatt, 600

revolutions per minute Northern generator belted to a Nash gas engine.

The Norton products, consisting of emery wheels and grinding machines made by the Norton Emery Wheel Company and the Norton Grinding Company, Worcester, Mass., were awarded two grand prizes and two gold medals at the St. Louis Exposition. The Norton Grinding Company received the only grand prize which was awarded for grinding machines.

The Western Electric Company, Chicago, Ill., has closed a contract with the Garden City Fan Company, Niles, Mich., and Chicago, Ill., to install its fan system of heating in the new shop now being erected by the Western Electric Company at Hawthorne, Ill. This machine shop will be one of the largest in the world, measuring 820x175 feet and 50 feet in hight.

The C. W. Hunt Company, West Brighton, New York, secured the highest awards on two of its exhibits at the St. Louis Exposition. The third was not entered. The Hunt industrial railway received the gold medal for narrow-gage railways, and the electric storage battery locomotive built by that company received the silver medal, being the highest award for this type of locomotive.

Manufacturers.

The Howe Scale Company, Rutland, Vt., will build a boiler-house.

The Lima (O.) Locomotive & Machine Company is about to build additions.

The new factory of the Winnipeg (Man.) Casket Company has been burned.

Bour Bros., brick manufacturers, Lima, O., have under way plans for a new plant.

The American Pencil Company's plant at Lewisburg, Tenn., will soon be rebuilt.

The Davis Warehouse Company, Columbus, Ga., has bought a fertilizer factory site.

John J. Railey has let a contract for an apple parer factory at Leominster, Mass.

The Watson cresting factory at Crawfordsville, Ind., is to be enlarged in the spring.

It is reported that the Texas & Pacific Railway will build car shops at Fort Worth, Tex.

The Mobile (Ala.) Lumber Company's sawmill plant, recently burned, is expected to be rebuilt.

The Elk Lumber & Manufacturing Company, Fernie, B. C., is about to build a new sawmill.

The Omaha (Neb.) Lincoln & Beatrice trolley line is considering the development of water-power.

The Fort Wayne, Van Wert & Lima Electric Railway will build a power plant at Ft. Wayne, Ind.

The Alabama Steel & Wire Company expects to build a steel wire rod and wire mill at Gadsen, Ala.

The H. Wetter Manufacturing Company, stoves, is erecting a factory building at South Pittsburg, Tenn.

The plant of the Columbia Plate Glass Company, Blairsville, Pa., is expected to be greatly enlarged.

Fire has damaged a brass foundry of the Neafie & Levy Ship & Engine Building Company, Philadelphia.

An appropriation of $76,369 may be made at St. Joseph, Mo., to equip and build an electric light plant.

Golden's Foundry & Machine Company, Columbus, Ga., is to enlarge the foundry and machine shops.

The Zehner Bros. Packing Company, Bellvue, O., is considering whether to build a plant in Toledo also.

New buildings of the Meyersdale (Pa.) Manufacturing Company, builders' hardware, are nearly completed.

The Gaithersburg (Md.) Milling & Manufacturing Company will erect this fall a mill to cost about $30,000.

The Ontario Knife Company, Franklinville, N. Y., has passed into new control, and the factory will be enlarged.

The planing mill of Captain Samuel S. Brown, at Brown station, opposite Homestead, Pa., has been burned.

The E. Stebbins Manufacturing Company, Brightwood, Springfield, Mass., brass foundry, is building an addition.

A $100,000 merchant bar mill employing 300 men may be built by the New Castle (Pa.) Forge & Bolt Company.

The Commercial Club, Brownsville, Tex., is said to be trying to organize a $200,000 company to build a cotton mill.

Contract has been let for the building of a large carbon works at Clarksburg, W. Va., for the Washington Carbon Company.

The Barber-Colman Company, manufacturer of machinery for knitting industries, is doubling its plant in South Rockford, Ill.

The Philadelphia (Pa.) Rubber Works will expend about $200,000 on a group of buildings, for which the contract has been let.

The Union Guano Company, organized by Winston-Salem, N. C., capitalists, will establish a plant there and one at Norfolk, Va.

John E. Redin, who has a machine shop at Rockford, Ill., will erect a two-story building, which he will utilize in part for his shop.

The Chamber of Commerce, El Paso, Tex., is negotiating with J. S. Tebbetts, Riverside, Cal., for the establishment of a glass factory.

The Whitlock Coil Pipe Company expects to increase its factory facilities at Elmwood, Conn., by a 200x50-foot building, two stories.

B. T. Cass & Co., picture frames and moldings, Chicago, Ill., have secured a site of 191x92 feet and will erect a factory to cost $35,000.

A site near Phoenix, Ariz., has been secured for shops for the Phoenix & Eastern and the Santa Fe, Prescott & Phoenix Railroads.

The Delaware & Hudson Railroad will commence the work of building its roundhouse and shops at North Albany, N. Y., next spring.

Capitalists of the vicinity of Scranton, Pa., are going to furnish the city of Monterey, in Mexico, with a water and drainage system.

The Singer Company, Elizabeth, N. J., has purchased the old Worthington pump plant and considerable conjecture exists as to the purpose.

It has been reported that the Lima, O., shops of the C., H. & D.-Pere Marquette system will be enlarged next spring to double capacity.

An addition for blacksmithing and welding purposes is being built to the shop at Washington, Pa., of B. D. Northrup, machinist and founder.

Baldwin, Tuthill & Bolton, manufacturers of machinery for sawmill purposes, Grand Rapids, Mich., are about to erect a two-story factory building.

The Kursheedt Manufacturing Company, laces and embroidered goods, New York city, is understood to be about to build a factory in East New York.

The Commercial Club, Terre Haute, Ind., is in touch with an Indiana man who seeks to organize a company for the manufacture of a soil cultivator.

It is reported that the Cincinnati Southern Railway is planning an extensive addition to its shops, to be made at Chattanooga, Tenn., or elsewhere.

The Board of Trade, Martin's Ferry, O., is in touch with a concern which it wishes to secure for that place and which would manufacture certain iron products.

The Brewer-Pryor Piano Company, Saginaw, Mich., expects to move to Binghamton, N. Y. Frank Beman, organ builder, of Binghamton, will consolidate with it.

The Maize Products Company, recently organized, of which Augustus P. Murdock is manager, has bought a building at Oswego, N. Y., to equip as a starch factory.

It is reported that a New York corporation called the Electric Rubber Company has acquired a plant at East Rutherford, N. J., which it will enlarge for its purposes.

M. H. Kingsbury, of Schenectady, N. Y., has visited Little Falls and conferred with the Merchants' & Manufacturers' Association relative to a site for a storage battery plant.

The directors of the United States Lumber Company, which has headquarters in Scranton, Pa., have decided to erect another mill with a daily capacity of 250,000 cubic feet.

The Handy Tool Company has been looking for a manufacturing plant in Syracuse, N. Y., with a view of removing to that city. Its present location is said to be Fort Plain, N. Y.

George Grigg has moved from Coffeyville, Kan., to Carthage, Mo., and has arranged to organize a company for manufacturing a patent grain door for freight cars, an invention of his own.

John S. Woodbridge has bought out the interests of his partner, Emil Coelius, in the Woodbridge & Coelius Machine Company, manufacturers of match-making machinery, Detroit, Mich.

George A. Martin and his son, John, have formed a partnership and will engage in manufacturing hosiery at Reading, Pa. They will also manufacture a stop-motion device for knitting machines.

It is reported that the Columbus (O.), Delaware & Marion Electric Railroad Company will be taken over by a newly incorporated company, of nearly the same name, and a new power-house built.

John A. McCall, recently of Moberly, Mo., proposes to build in Council Bluffs, Ia., a factory for hay tools, wagon boxes and dump boards. He will move his machinery from Moberly and add to it.

Francis H. Clergue and associates are to build at Sault Ste. Marie a coking plant that will consume annually nearly half a million tons of coal. Gas will be one of the by-products and will be used locally.

Plans have been prepared for a new engine-room and power-house for the Skinner Engine Company's plant, Erie, Pa. Plans for additions to the main shop are being prepared and will be ready in January.

Members of the Chamber of Commerce and Manufacturers' Association, Chattanooga, Tenn., have visited Elwood, Ind., to try to get the Elwood Lawn Mower Company to move or build a plant in Chattanooga.

Application has been made for a permit to erect a manufacturing building at 1238-1242 Harrison avenue, Cincinnati, O., by the Joseph Joseph & Bros. Company, dealer in railway iron, metals, etc. It is to cost $20,000.

A citizens' committee from Monroe, Mich., went to Toledo, O., to meet representatives of a firm engaged in the manufacture of stationary and marine gasoline engines, which has an established business and is looking for a new location.

Things That are Usually Wrong—II.

BY JOHN E. SWEET.

Something over thirty years ago, in a series of articles in *Engineering*, I advocated to a considerable extent the advantage of equal length wearing surfaces, and being at that time in a position to put my ideas in practise, had built, among other things, a milling machine in which both the knee on the column and the horizontal slide had equal length wearing surfaces. The machine has been in use ever since and neither slide has worn enough to need taking up, much less refitting. We built a punching machine in which the slide was a mechanical fit without any provision for taking up wear. The last time I saw it, it was in perfect condition. The cross-slide of the lathe built in 1882, illustrated in the AMERICAN MACHINIST in 1889, has never had the slack taken out of it.

The first Straight Line engine, built in 1872, had crosshead and guides of equal length, and when worn out both were as truly straight as when made. Ever since those days I have been preaching right and doing both right and wrong—right when I had the courage and wrong when I was silly or too much of a coward.

Two or three years ago I put in words what I believe to be a fact, that "Things that do not tend to wear out of true do not wear much." The cases I have enumerated above go to confirm this on the one hand, and I have recently had occasion to confirm it on the other. Mr. Porter, in his "Reminiscences," tells of running crossheads for years without wearing out the scraper marks.

We have been building engines of the slipper guide sort with the crosshead shoe equal to the length of the stroke and the guides considerably longer—that is, about half way between what other engine builders would make them and the length of the stroke. These surfaces were always scraped to surface plates much larger and as true as Mr. Porter could get his made, I believe, and we never could get any such result as he claimed. The scraper marks would always soon disappear in the middle of the guide, and this to any observant man ought to have been enough to convince him that the guide was too long. We understand that it is better to make the sliding piece longer, but won't do it because it costs more money, and we won't cut off the guide and save money, because why? There is another element entering into this slipper guide crosshead proposition, and it may be well in this connection to explain it. Fig. 6 shows the crosshead and guide. The crosshead, it will be understood, overruns the guide half of its length at each end, and if on a slow-speed engine no doubt the guide would wear off the most at the ends, but in the case of the high-speed engine, inertia and momentum change the conditions.

It will be seen that the center of gravity of the crosshead is below the center line of piston rod and connecting rod. When the piston is at the end of the stroke as shown, and starts back, the inertia of the crosshead tends to rotate it around the crosshead pin and so tends to wear out the middle of the guide, and at the end of the stroke being resisted by the connecting rod tends to do the same thing, so that while gravity would tend to wear off the ends, inertia and momentum tend to wear out the middle, one balances the other, and now we have a cheaper guide and one that shows no evidence of wear whatever. This cutting off of the guide led to trouble in another way. It has always been the aim to hold the escaping oil at such a hight that it would be drawn on to the guide by the crosshead, but with the short guide the crosshead would strike it while going at its highest velocity and splash it all over the engine-room. The ratchet surface suggested by Mr. Armstrong not only prevents this but to a much greater extent than when the guide was full length.

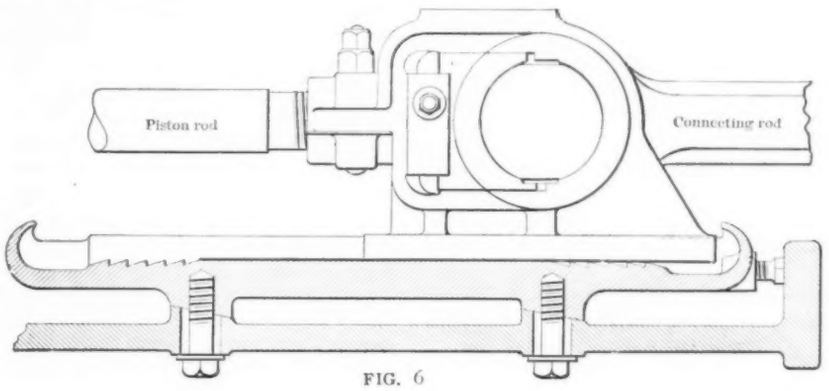


FIG. 6

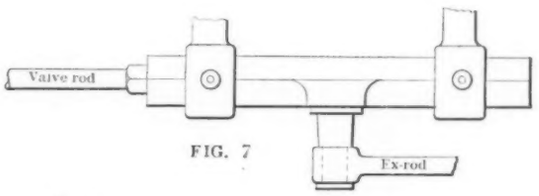


FIG. 7

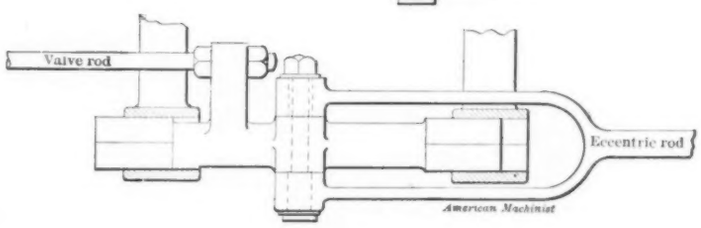


FIG. 8.

RIGHT AND WRONG THINGS.

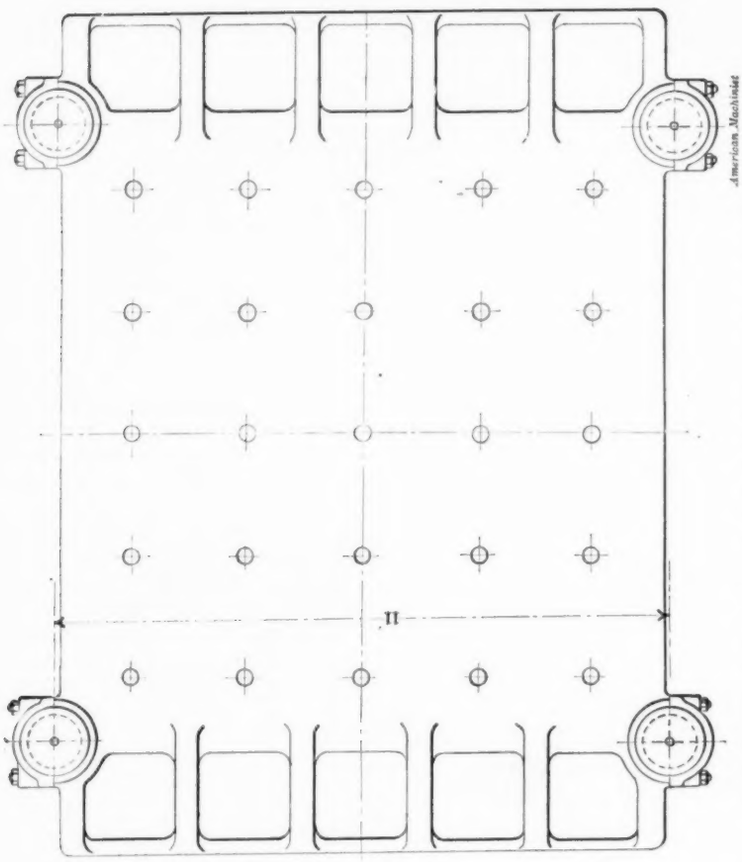
This world is too large and time has been too long for one to be safe in saying anything is new, but certainly this treatment of the subject is not common and it is right.

The crosshead and guide are not the only things in steam-engine practise that are usually wrong. The valve rod guide in the regular run of slide-valve engines is as bad as it well can be. Fig. 7 shows a common form and Fig. 8 the same thing without much change except in locating the guides farther apart, and cutting off the wearing surfaces so as to make them of equal length. I am not foolish enough to think that the old engine builder who is making his valve rod slides like Fig. 7 is going to change them to be like Fig. 8, nor am I sure that I can convince the old men that the old way is all wrong and the new one right, but it is true and I believe the rightly trained college man will believe me.

Forty or fifty vacuum engines made this way, which have been running twelve or fifteen years and show absolutely no wear, prove it. If they do wear, the slack can be taken up without redressing the wearing surfaces, whereas in the original form they are sure to be loose in the middle of the stroke and tight at the ends.

The form shown in Fig. 7 is wrong in another respect. The eccentric rod tends to swing each end of the slide back and forth at every stroke, which cannot be avoided in any way, but owing to the angularity of the eccentric rod it tends to rotate the square bar in its guides at every stroke, which is far worse than the side pull. By the central pull shown in Fig. 8 that is avoided.

I know ninety-nine out of a hundred are going to say, "See what it costs!" I am not arguing the cost, but the right and wrong. The principle may come in play in many places beside the valve rod slide of a common engine.



Design of a 4,000-Ton Hydraulic Press—I.

BY W. E. MOREY.

For work requiring the moving of great loads thru comparatively small distances, the hydraulic system offers the most economical solution of the power problem, allowing as it does the transmission of energy, thru the medium of the pressure pipe, to any distance in any direction, and with no serious losses, while the secondary source of power, the hydrostatic press, may be adapted to meet any required conditions, being limited only by the strength of the materials of which it is constructed.

The scope of the present paper does not permit of any discussion of the prime mover, the pump, but requires that we confine ourselves strictly to the press itself, with a view to designing one at once useful in a plant already established and also correct, as near as may be, from the standpoint of the engineer.

The choice of any particular form of press, tho governed for the most part by the class of work for which it is designed, is also influenced in a measure by existing conditions or systems to which it must conform, and in choosing the type which it is intended to set forth in these pages, it is necessary to take note of the following requirements and to work out the design in accordance thereto.

Primarily, the work to be done may be

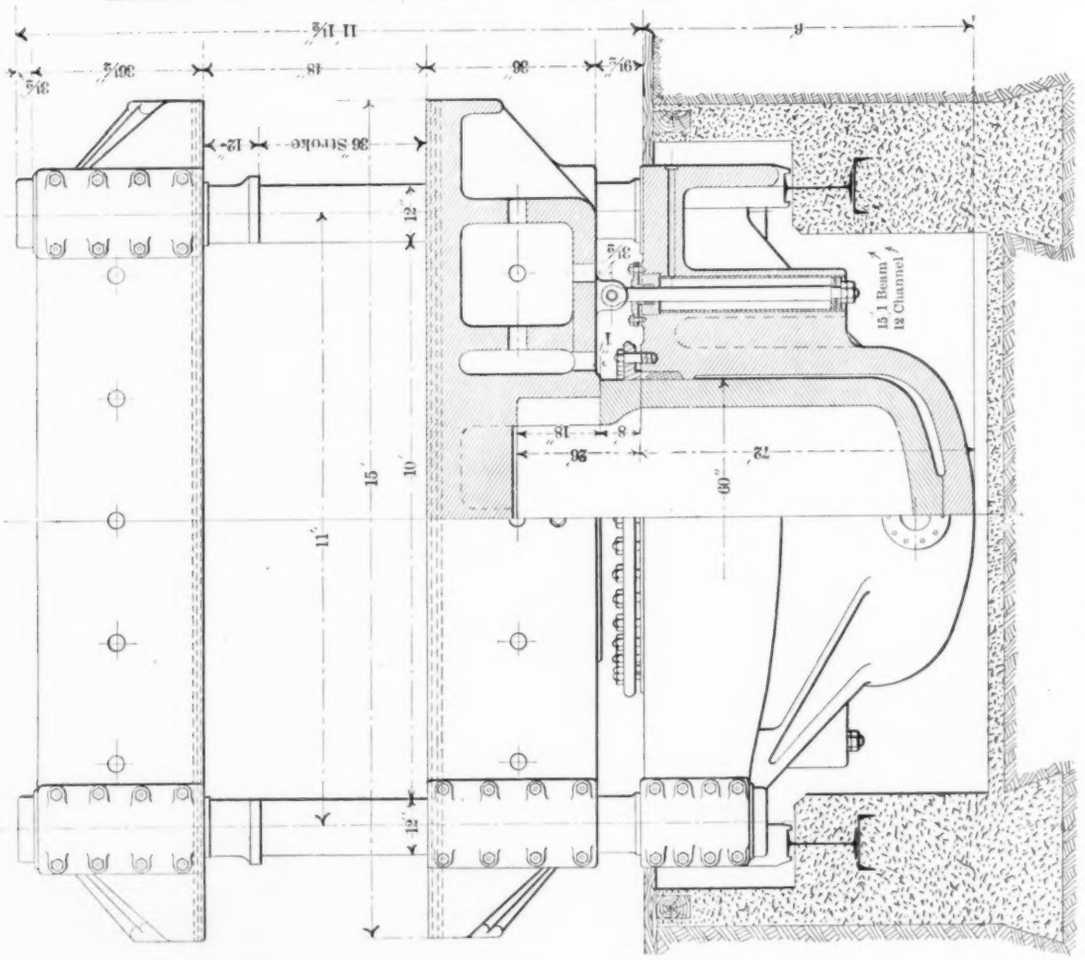


FIG. 1. GENERAL DRAWING OF PRESS.

roughly divided into two classes—shaping or forging, making necessary a long stroke and great power; and shearing and punching, which demand accurate alinement of the parts.

Secondly, the size of the work—*i. e.*, in superficial area—requires that the platens be broad, in order to permit the use of large dies and to facilitate the handling of the same.

Thirdly, the existing system consists of three separate lines of pipe, with pressures ranging from 300 to 3,000 pounds per square inch, and the press in question must be designed to operate under the highest pressure with safety.

Fourthly, experience has demonstrated that new equipment should provide a generous margin for expansion and be designed to accommodate work considerably larger than any hitherto attempted.

With these ends in view the type shown on the attached drawings has been adopted.

The capacity desired was assumed, bearing in mind the aforesaid factor of expansion, at approximately 4,000 tons, to which was added a pull-back resistance of 100 tons, which is required to strip punches and dies and to return platen rapidly to place after a stroke. This pull-back resistance is secured by the use of two small cylinders shown on opposite sides of main cylinder in Fig. 1, and connected directly to the 3,000 pounds pressure main.

To give this gross pressure of 4,100 tons with a gage pressure of 3,000 pounds requires a cylinder diameter of 58.9 inches, as determined by formula 1, but since it is not my object to adhere too rigidly to the original assumptions, I will adopt 60 inches as the diameter and determine later the effective load.

The friction of packing for the main cylinder is found by formula 2 to be 18 tons, the friction of the pull-backs being so small as to be negligible, while the loss due to weight of moving parts is roughly estimated at 25 tons. The total pressure on a 60-inch ram is, by formula 3, equal to 4,241 tons, and deducting the losses previously mentioned we have an effective pressure of 4,098 tons.

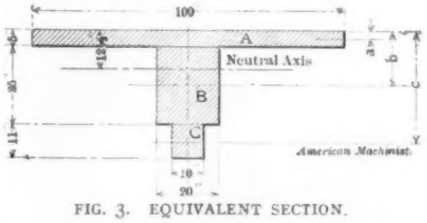


FIG. 3. EQUIVALENT SECTION.

In designing the cylinder, the calculations are based on the assumption that the diameter is so large in proportion to the probable thickness that we may neglect the variation of stresses due to varying distances of the layers of metal from the center and by formula 4 the required thickness is found to be 5¾ inches. It will be noted that there is a clearance of ¼ inch all around the ram, making the inside diameter of cylinder 61½ inches. It is possible that if account was taken of the variation of stresses between inner and outer layers, the maximum stress would run as high as 18,000 pounds per square inch, but as the tensile strength of steel castings runs from 67,000 to 76,000 pounds per square inch, this variation is, as stated, negligible.

In order to maintain the same thickness of metal in the head of the cylinder, thus insuring a uniform casting and minimizing shrinkage strains, we will make the inner radius of the head equal to inner diameter of cylinder or 61½ inches, as shown in Fig. 2.

The type of tie rod shown embodies both a tension member and a guide for the lower or movable platen. As a tension member the rod must have sufficient area to resist a force of 2,049,000 pounds and by formula 5 we find the least diameter to be 11½ inches, using nickel steel with a working stress of 20,000 pounds per square inch.

In order to facilitate assembling the press, the tie rods are secured both to cylinder and to the platens by connections resembling a journal box and cap, as may be seen in Fig. 1.

The diameter of head required for the ends of rods is dependent on the crushing resistance of the material of which the castings are composed and is determined by formula 6 to be 14½ inches. These heads are also subject to shearing stress around the circumference of the 11½-inch circle, and we find by using formula 7 that the required depth of the head is 1.77 inches. It will be advisable, however, as a concession to appearances to increase this depth to at least 3½ inches, as has been done.

The wearing or guiding portion of these rods is made 12 inches in diameter, with a shoulder at each end to make a larger bearing against castings. Another shoulder 12 inches from upper platen limits the travel of lower platen to 36 inches and insures that the ram cannot at any time be forced out of cylinder, either by leakage of admission valve or other cause when no dies are in the press. These stop shoulders are planed away as shown on assembled drawing in order to give a clear space of 10 feet between tie rods in both directions. It will be noted that the upper end of each tie rod is provided with a hole tapped to 1½ inches for the insertion of an eyebolt to be used in assembling. Other parts of the press are supplied with tapped holes of various diameters for the same purpose. The cylinder casting, besides the cylinder proper, consists of a flat plate, as shown in Fig. 2, with a rib along each side and eight diagonal ribs in pairs extending from the cylinder to the rods which are attached, as previously described, at each corner. To secure the necessary strength to resist the bending action due to the thrust of the ram in the center of this casting, we will make the top plate of cylinder casting 5 inches thick. The side ribs will extend to a depth of 25 inches b low top plate and the diagonal ribs will be 46 inches deep at the cylinder wall. In calculating the moment of inertia of the casting, we will consider it by taking the section on line *X X*, Fig. 2. This section consists of a top flange 5 inches in depth and 100 inches in breadth, two side ribs 25 inches in depth and 5 inches in breadth, and two center ribs 36 inches in depth and 5 inches in breadth; the whole

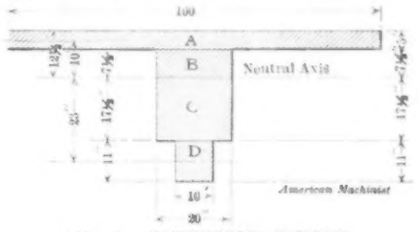


FIG. 4 EQUIVALENT SECTION.

reducing to the simple equivalent form shown in Fig. 3. The distance from the center of the rod where load is applied to this section *X X* is 43 inches.

By formula 8 we find the center of gravity or neutral axis to be 12½ inches from the top surface and by taking the moment of inertia of the different sections, as by formula 9, we find the total to be 148,880, while the distance of outer fiber from the neutral axis is 28½ inches. Using the resulting section modulus 7255 in formula 10, we have as the maximum fiber stress 16,869 pounds per square inch.

The caps which hold the tie rods in place are secured against shearing by three lugs or keys 2 inches wide and 1 inch deep which give a surface-resisting shear of 45 square inches. These keys are set into the large castings which have projecting surfaces at each corner for fitting. This prevents weakening the small castings by cutting into them, while the direction in which these fitting surfaces lie permits them all to be planed at one setting.

Altho, theoretically, no outward stress exists, as a matter of appearance and for added security each cap is held in place by eight 1¼-inch studs, for it is probable that in service the rocking of the platens really induces stresses of considerable magnitude in this direction.

FORMULAS.

1. $$D = \sqrt{\frac{L}{\frac{\pi}{4} \times p}}$$

L = required load of press in pounds = 8,200,000.

D = diameter of ram in inches.

p = pressure in cylinder in pounds per square inch = 3000.

$$D = \sqrt{\frac{8,200,000}{.7854 \times 3000}} = \sqrt{3479} = 58.9 \text{ in.}$$

2. $F = f \times D \times p$.

F = friction of packing in pounds.

D = diameter of ram in inches = 60.

p = pressure in pounds per square inch = 3000.

y = factor depending on kind of packing used = .2.

$F = .2 \times 60 \times 3000 = 36{,}000$ pounds = 18 tons.

3. $L = \dfrac{D^2 \times \pi \times p}{4 \times 2000}$

L = total load of press in tons.

D = diameter of ram in inches = 60.

p = pressure in pounds per square inch = 3000.

$L = \dfrac{3600 \times 3.1416 \times 3000}{4 \times 2000} = 4241$ tons

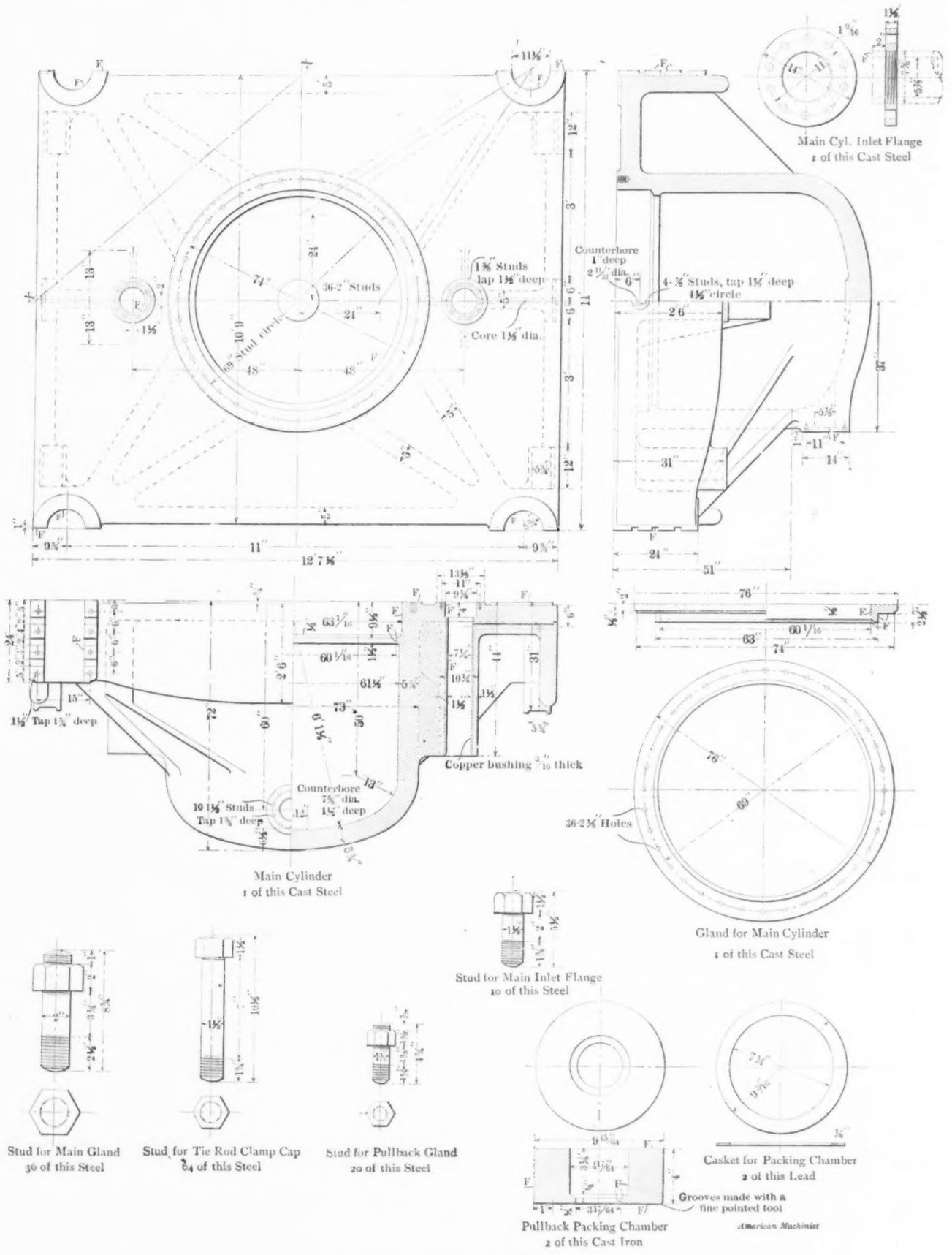

Main Cyl. Inlet Flange
1 of this Cast Steel
36-2" Studs
Core 1½" dia.
Counterbore 1" deep 2 11/32" dia.
4-⅞" Studs, tap 1½" deep 14" circle
Main Cylinder
1 of this Cast Steel
Copper bushing 3/16" thick
36-2⅛" Holes
Gland for Main Cylinder
1 of this Cast Steel
Stud for Main Inlet Flange
10 of this Steel
Stud for Main Gland
36 of this Steel
Stud for Tie Rod Clamp Cap
64 of this Steel
Stud for Pullback Gland
20 of this Steel
Casket for Packing Chamber
2 of this Lead
Grooves made with a fine pointed tool
Pullback Packing Chamber
2 of this Cast Iron
American Machinist

FIG. 2. DETAILS OF PRESS.

4. $T = \frac{p \times D}{2 \times f}$

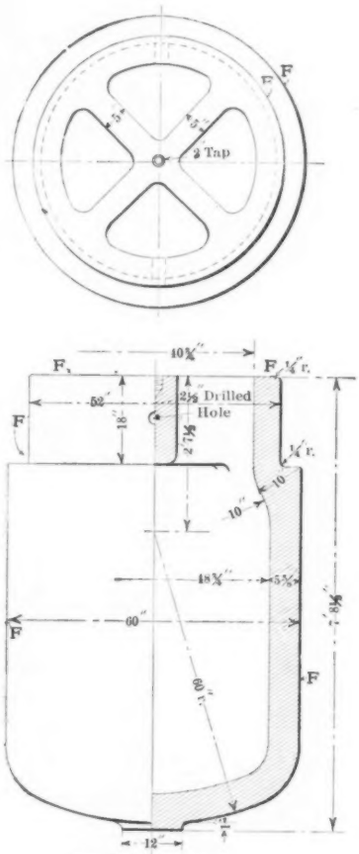
T = thickness of cylinder in inches.
p = pressure in pounds per square inch = 3000.
D = diam. of cylinder in inches = 61.5.
f = working stress of metal or 16,000 pounds per square inch.

$$T = \frac{3000 \times 61.5}{2 \times 16{,}000} = 5\tfrac{3}{4} \text{ inches.}$$

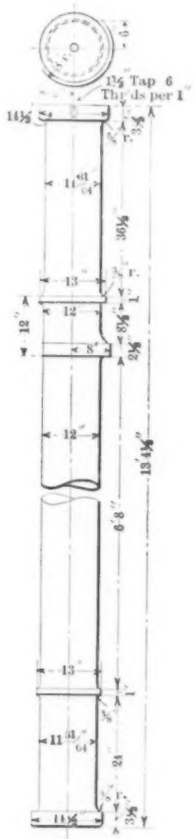
5. $D = \sqrt{\frac{L \times 4}{f \times \pi}}$

D = diameter of tie rod in inches.
L = load on rod in pounds = 2,049,000.
f = working stress of metal or 20,000 pounds per square inch.

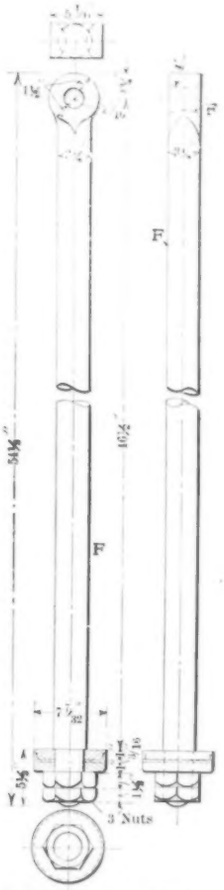
$$D = \sqrt{\frac{2{,}049{,}000 \times 4}{20{,}000 \times 3.1416}} = 11.4 \text{ or } 11\tfrac{1}{2} \text{ in.}$$



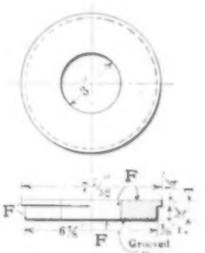
Ram for Main Cylinder
1 of this Cast Steel



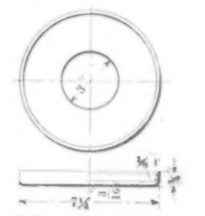
Tie Rod
4 of this Nickle Steel, finish all over



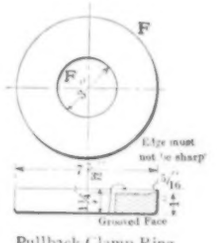
Pullback Piston and Rod
2 of this Rod and Nuts, Mach. Steel



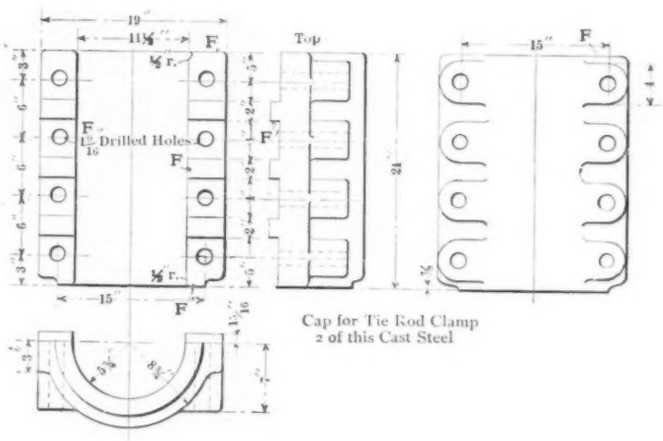
Pullback Piston Head
2 of this Cast Steel



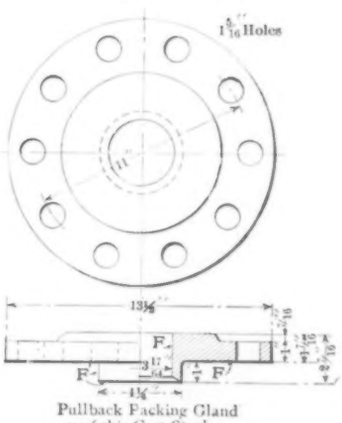
Pullback Piston Cup
2 of this Sole Leather



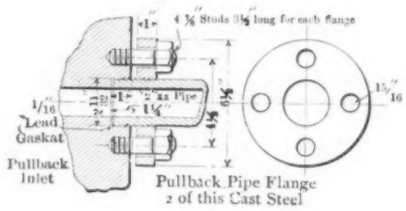
Pullback Clamp Ring
2 of this Cast Steel



Cap for Tie Rod Clamp
2 of this Cast Steel



Pullback Packing Gland
2 of this Cast Steel



Pullback Pipe Flange
2 of this Cast Steel

American Machinist

FIG. 2. DETAILS OF PRESS.

6. $D = \sqrt{\frac{L \times 4}{f \times \pi} + d^2}$.

D = diameter of tie-rod head in inches.
d = diameter of tie rod below head in inches = 11½.
L = total load on rod in pounds = 2,049,000.
f = crushing stress of casting or 32,000 pounds per square inch.

$$D = \sqrt{\frac{2{,}049{,}000 \times 4}{32{,}000 \times 3.1416} + 132} = 14.6.$$

7. $l = \frac{L}{f \times d \times \pi}$

l = length of tie-rod head.
L = load on rod in pounds = 2,049,000.
f = shearing stress of metal or 32,000 pounds per square inch.
d = diameter of rod below head.

$$l = \frac{2{,}049{,}000}{32{,}000 \times 11.5 \times 3\ 1416} = 1.77.$$

8. $X = \frac{Aa + Bb + Cc}{A + B + C}$

X = distance of neutral axis from top face.
A = area of top flange.
B = area of second section.
C = area of lower section.
a, b, c = distances of respective centers of sections from top face.

$$X = \frac{(500 \times 2.5) + (500 \times 17.5) + (110 \times 35.5)}{500 + 500 + 110} = 12.5.$$

9. $I = Ia + Ib + Ic + Id$ = total moment of inertia of section.

$Ia = (\frac{1}{12} \times 100 \times 5^3) + (100 \times 5 \times 10^2) = 51041$
$Ib = (\frac{1}{3} \times 20 \times 7.5^3) \quad - \quad - \quad - \quad = 2812$
$Ic = (\frac{1}{3} \times 20 \times 17.5^3) \quad - \quad - \quad - \quad = 35728$
$Id = (\frac{1}{12} \times 10 \times 11^3) + (10 \times 11 \times 23^2) = 59299$
148880

10. $p = \frac{Me}{I}$

p = working stress of metal in pounds per square inch.
M = bending moment at section X, X in inch-pounds = $\frac{L \times l}{4}$
L = total load of press in pounds = 8,196,000.
l = length from tie rod to section X, X in inches = 43.
M = 88,107,000 inch-pounds.
I = moment of inertia of section = 148,880.
e = distance of outer fiber from neutral axis in inches = 28.5.

$$p = \frac{88{,}107{,}000 \times 28.5}{148{,}880} = 16{,}869.$$

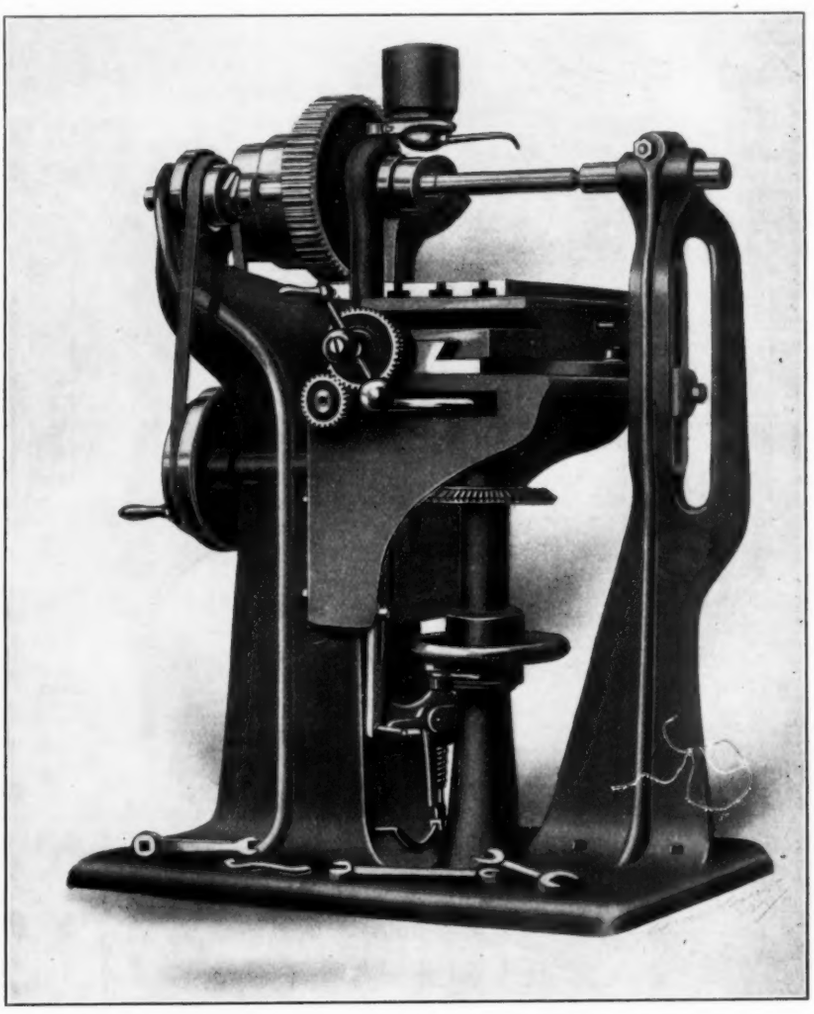
An anonymous correspondent has sent us in the old puzzle of the blacksmith who had five pieces of chain of three links each which he had to cut and weld into a continuous chain of fifteen links, the question being how many links had to be cut and rewelded. The trick can be done by three cuts and welds; so it would be foolish to make four such cuts and welds, as many would do. So many of these tricks and puzzles are old, we moderns have little chance to originate.

Milling Machine With Slides and Guides of Equal Length.

In the article on another page by Professor Sweet, relating to things that are generally wrong, mention is made of a milling machine in which the wearing surfaces of the slides and guides were of equal length. We reproduce herewith from *Engineering* of April 21. 1871, an illustration of this machine.

In the article in which it appears, which relates to milling machines in general, this passage appears: "The great defects in milling machines are the want of stability in the machine or stiffness in the mandrel, insufficient means for holding the work and a lack of positive forward motion in the traveling bed, all or either of which will cause the work to be performed with a jerking or stuttering action, rough and unsatisfactory and ruinously destructive to the tools."

In the description of the machine these passages occur: "The horizontal feed can be turned to an angle of 30 degrees. The vertical feed screw is directly under the work, the horizontal screw as near up to it as it well can be, the mandrel is usually supported at both ends, tho the outer post can be easily removed when the nature of the work renders it necessary. The sliding surfaces are of uniform length, the bearings are conical, running in solid boxes, and all the wheels are screwed on like the face-plate of a lathe." The machine is still in use in Syracuse and there is no evidence that the main slides have ever needed readjustment even, much less refitting, because of slack motion.



MILLING MACHINE HAVING SLIDES AND GUIDES OF EQUAL LENGTH.

The Present and the Future of Engineering on the Pacific Coast — Engineering Experience.

The proceedings of the Technical Society of the Pacific Coast, coming to us thru the *Journal of the Association of Engineering Societies*, represent the highest and best in American professional literature. A wide range of engineering experience is recorded, and especially prominent are the solutions of problems which arise from the special and peculiar conditions which dominate the Western shores of our continent. We give here an abstract of the inaugural address of George W. Dickie, who has again been called to the presidency of the society:

Much of an engineering character that is going on now on the Pacific Coast is unknown to the profession outside of those within sight of the work being done

or directly concerned in the financial or engineering problems involved. The result of this is that the engineer and his work on the Pacific Coast are unknown to the world at large. In the transactions of the great engineering societies, or in the magazine literature of the profession, we can study the great engineering works being carried out in other parts of the world, but we do not appear to find time or opportunity to tell the world outside what we are doing here to utilize the vast natural resources around us. In this we are not dealing honestly either with ourselves or our professional brethren in other lands. While a number of us may be members of the National Engineering Societies, our isolated position makes it impossible for us to attend their meetings except perhaps once or twice in a lifetime, and in consequence we cut no figure in their transactions. We must therefore make the literature that will represent to the great world outside the work done by the engineers of the Pacific Coast. At present we do not know what we have done, what we are now doing or what we expect to do. It is therefore of the utmost importance to ourselves and a duty we owe to those who are to follow after us, that we meet together, from time to time, so that we may get to know each other, and compare notes as to what we are doing, thereby helping one another in the solution of the ever-present difficulties in all engineering problems. "As iron sharpeneth iron, so a man sharpeneth the countenance of his friend."

The engineering work now being carried out on this coast is beginning to be of a different character from that which used to characterize the work of the engineer. The permanent is taking the place of the temporary, which means that men of known ability will be in charge of such work, plans will be more carefully considered and by more experienced men than hitherto, and this is another reason why engineers should make their work known thru such societies as this; for what a man has done successfully will become more and more the measure of what he can do. We have many able engineers in the various branches of the profession here, some of them well known beyond the boundaries of the Pacific Coast, and there are many just as able who are not known. These men have been hiding their talents under a bushel. They may think that it is modesty on their part, but in most cases it is indifference, which is quite another thing. We have each been so absorbed in our own little engineering problems that we have failed to notice the growth of things about us. The opportunities for engineers to take their part in the development of the varied resources of the Pacific Coast have been steadily increasing, until now the field is a broad and attractive one, inviting us to take a hasty glance at what it offers to the men now preparing themselves to stamp their characters on some part of it.

In railroad engineering, always a large factor in the development of a country, we have already done much, but what has been done is only the beginning of what is ultimately to be a marvelous system of transportation, affording unlimited opportunity for engineering skill. The railroad engineers who planned the steel highways that have opened the beauties and riches of the Pacific Coast to mankind have left many traces of their skill amid the high Sierras that form our eastern bulwark, but these engineers have left little or no trace of their work in the annals of engineering. The temporary ways of the past are fast becoming the permanent ways of the future, as regards our railroads, and grand opportunities are to be afforded to the railroad engineers of the future. The mechanical engineer as well as the civil engineer will have his opportunity in the railroad development. Radical changes in the motive power are beginning to be felt as a necessity, and we seem to be on the verge of some great surprise in this field of engineering. Whether this is to come from improvements in the present type of prime movers at the heads of trains, or thru discarding the locomotive altogether and adopting some system of power stations where mountain torrents will be converted into electric energy to be applied by some new system to the railroad cars, cannot perhaps now be predicted, but I feel sure that some such change is in the near future. It might almost be said that a new science has been created to satisfy the demands of the electric railroad. Here the engineer has a field to work in that is almost virgin soil, and that field on the Pacific Coast is even now a wide one and its possibilities very great.

The development of water power on the Pacific Coast, which has already made creditable progress, is, I believe, destined to be one of the leading factors in the future prosperity of this State. Perhaps no section of the world's surface is better adapted to the utilization of water power than the Pacific Coast, with a background of mountains facing fertile valleys for more than a thousand miles in length and with streams rushing down the mountain sides at convenient intervals, having water heads as great as the mechanical engineer cares to deal with.

A kindred subject to the utilization of our water power resources is that of the direct application of steam to turbine wheels, which is now threatening the long-established supremacy of the reciprocating engine. Neglecting the claims of Hero of Alexandria, dating back some 2,000 years, we may say that the practical steam turbine is but a thing of yesterday, as it has not reached its majority yet as against the 200 years of the steam engine. It would be useless to conjecture what the prime mover may be 100 years from now, but there is little doubt that in the near future the infant steam turbine will, for many purposes, be a strong competitor with the maturely aged reciprocating engine. Hitherto we have been more interested in producing water wheels than steam wheels, but if the Pacific Coast should in the future do as much for steam wheels as it has done for water wheels, we will have an honorable share in the perfecting of this new steam motor.

Experience is the principal stock in trade of the engineer, and Pacific Coast experience differs from all other engineering experience. The world should therefore know that quite a fund of it has been collected by the professional men here, and while it is an individual asset of him who has gained it, I would not like to have you think that I had little faith in any other teaching than that of one's own experience. You must not let any such impression be made on your minds by anything I may say on engineering experience, for anything I may say had better not be said at all than that it should have such an effect. I had not in my younger days the opportunity to learn all the recorded experience of the best thinkers in my profession, as many of you have had, and I sometimes think that many a dark passage in my book of experience had been spared me if I had had such opportunities. You will understand, therefore, that when I speak of engineering experience I do not mean to say that that is the sum of all that an engineer ought to know, for the lessons to be learned in the school of experience will come easier and sooner to the man who builds his experience on a broad foundation extending deep into the accumulated experience of the profession.

What is the thing or quality of mind that men call experience? It is, I think, the formative or molding effect upon the mind of all the thoughts that pass thru it from within, and all the impressions received by it from without, relative to the work with which our lives are identified; and the mind becomes rich in experience in proportion to the concentration of thought within and the strength of the impressions from without in regard to the matters we desire to become experienced in.

Memory, I think, must be a powerful mental factor in experience; in fact, the man of experience is such by virtue of the store of impressions he has gathered and arranged in his mental storehouse in such order as to be readily produced at the moment when their evidence is required to decide his course of action in regard to the subject to which these impressions relate. When a plan or design for any engineering work is presented to an experienced engineer for his opinion as to its merits or practicability from an engineering or commercial standpoint, a series of pictures at once present themselves to his mind. Mental photographs, as it were, of similar works, or works of the same character that he has been connected with in the past—where they succeeded and where they failed—are clearly pictured to his mental vision, so that he will be able to readily compare these pictures in his

mind with the proposed plans before him; and as the pictures of failure or success most nearly coincide with the plans before him, so will his opinion be. This is experience, and it is the quality in an engineer that commands the highest price in the engineering market.

The brilliant young man who has been nursed at the public breast of recorded experimental data, but without any experience of his own, is often skeptical in regard to the experience of older men in the profession. He considers engineering as an exact science, and that all problems in engineering are capable of demonstration, and that if the past work of any engineer had been carefully figured out in all its details by the methods he has learned to understand so thoroughly, these mental impressions I have referred to, so far as they represent finished results, would simply all be brilliant pictures of success.

I have no doubt about engineering being an exact science, but the engineer has not yet discovered the exact way to apply the science of engineering to the ever-shifting conditions under which he must do his work. His most careful and exactly figured-out designs sometimes surprise him by utter failure, while another design, under quite as difficult conditions, that he has given less time and thought to, may equally surprise him by its complete success. The static laws and dynamic forces in his most carefully planned machines sometimes get into most fatal misunderstandings with each other, and he stands puzzled amid the mechanical wreck without any satisfactory reason furnished by the result to show why the thing that figured out so exactly right should be so hopelessly wrong. But if he is a wise man the impression will not be lost, and will always be ready whenever his opinion is required on a class of mechanism of which this picture is a type.

Did you ever observe the difference in appearance between a piece of mechanism designed on scientific principles, with every part figured out to stand the strain that theoretically should come upon it, every journal having just the proper amount of surface for the load, and another piece of mechanism for the same duty, but developed by experience with the working of many predecessors? No scientific reasons could be given for the forms that certain parts had developed into, except that they would not work satisfactorily in any other form. It is not safe for any engineer to look upon general practise as the result of lack of knowledge. In all our designs we are on dangerous ground when we neglect the teaching of general experience. I have said something about engineering being an exact science; this is true only in part. The laws that govern bodies in motion and at rest, the expansion of gases, the conservation of heat and energy, are all exact in their operation, and the same conditions will always produce the same results. But the engineer has to apply these laws and forces thru materials, used in the construction of the work he designs, that are varying in their qualities of strength and endurance, and what will behave satisfactorily at one time may utterly fail at another time, when to all appearances the conditions are the same.

Two metal surfaces may work on each other as a journal and bearing with perfect results at one time, leading you to believe that you had reached the desired end of your search for a satisfactory bearing metal; yet when you duplicate it under apparently the same conditions, the result is a disappointment, showing that your first experience, tho successful, was very near a failure, only you did not know it. This is why an experienced engineer will sometimes not repeat work that those not in his confidence may have considered a great success.

This illustrates what I mean by saying that no man can impart his experience to another, as it is acquired for his own use only. If we were to be guided by another's experience, progress would be at an end in certain directions. Men have found by experience that certain things could not be done, because they have tried and failed to do them, and this experience was enough for them. They may also have given the world the benefit of their experience, telling others that such things could not be accomplished, because they had tried and failed; yet other men searching for an experience for themselves will try and do those very things that could not be done, and do them sucessfully, and thus gather an experience that contradicts that of the other. And this process goes on continually. What my experience tells me will fail, another's experience tells him will succeed, and yet my own experience must guide me, and not that of another.

Experience is a thing of slow growth, for often the first impressions produced by our work have to be modified as certain tendencies on the part of the work develop. This is especially true of moving mechanism. An engine or machine may make a fine start, engineering experts may give good reports in regard to it, and the designer may feel justly proud of the result of his labor; but by and by certain tendencies begin to manifest themselves; workmen are employed nearly every night to keep it in condition to run in working hours but the fatal tendencies keep developing, until the machine is broken in constitution and is no longer fit for duty and must be abandoned. This is the end of many a fair start; and alas! how many of the model engines and machines that get conspicuous illustration and description in engineering publications come to just such an end, while other machines that required careful nursing at the start have developed constitutional strength that enabled them to serve their day and generation with credit.

I have found it very instructive to go back ten or twenty years and study the designs for engines and other machinery that figured in the engineering papers and magazines, and that were advertised at the time as the result of the best experience of the people who made them, and trace them on thru succeeding years, noting how many of those receiving the highest commendations drop out of existence altogether, experience having shown them to be constitutionally defective; while others having sound constitutions as a foundation for development appear again and again, modified to suit varied conditions, but still showing thru all changes the good stock from which they sprung.

Our own experience must be the result of wider observation than the limited horizon of our own work. We must make careful studies of other men's work. We cannot get their experience, but we can test our observations of what others do by an experience of what we have done in the same line ourselves, and thus enrich and broaden our ideas of the possibilities within the branch of engineering in which we have chosen to labor.

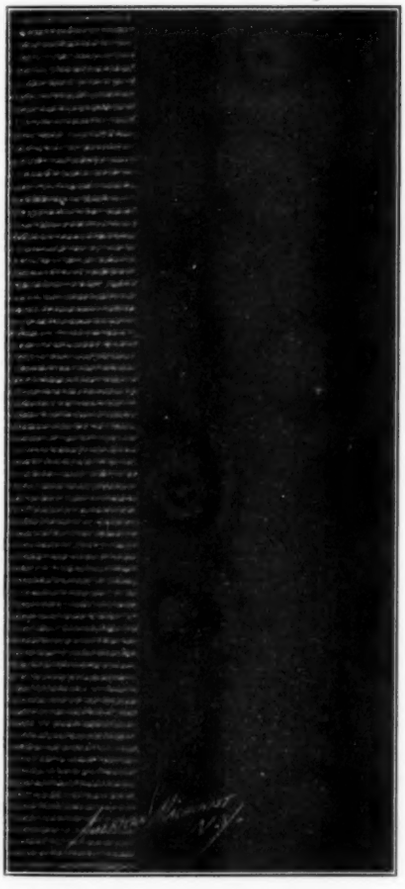
It should be the aim of every engineer to make himself an ever-growing power in his profession. This he can only do by continually increasing his resources, by carefully hoarding every item of experience that comes to him, either thru failures or successes; both must often come to the man who leads a busy life in our progressive profession.

It is not at all necessary to parade our mistakes, even before the Technical Society. These lessons are for ourselves only; others may have to pay for them, but the profit should be ours. It is the duty of every engineer to hide his mistakes as far as possible; he should be the first to discover them and the most qualified to correct them, and, above all, he should be the last to forget them, for the memory of them is his experience.

Individual experience is a growth, beginning with the first child effort to make something and the impression that product made on the young mind that produced it, showing the direction in which a better thing might be made, the thing produced giving the mental stimulus for the next and higher production; and thus should our experience grow richer and stronger as our lifework advances. Careful observation of the things we have made, performing the functions for which we made them, enables us to make better things in the future, having more varied functions. It is the man who is most critical of his own work that becomes the man of rich experience. We must get on very intimate terms with our own work if it is to be the mine from which we are to dig the experience that will make us a power in our profession.

Some young men think when they have taken a course in engineering at a university that that should give them a place in the profession; but that is not so. The fact that they have learned something of

engineering at a university places them under great obligations to the profession, for they have been receiving out of the accumulated store, gathered by the best men of the past; and it is not what one gets, but what one gives to the profession that will make him a place among its honest members; nor can he borrow what he gives—it must be his own honest work. Therefore, I would say to the young men who are trying to find an honorable place among engineers: Don't go around seeking for friends to get you a place, but make up your minds what place you would like, and don't be afraid to make it high enough. Then to work! no matter how distant that work may be from the place you aspire to, if it points in that direction. Stick to it; don't waste time consulting with friends about your prospects and seeking introductions to people who will help you to the place you desire to reach, but make a close friend of your work—your best advice and surest advancement will come from it. Study the results of your work while others are seeking influence; put these results in the clearest language you can command and bring it to the Technical Society. Let no tendency in your line of work escape you. Feed your experience by close observation, and some day someone will want something done for which your experience is absolutely indispensable. You will need no one to introduce you to that man; he will search for you and be very glad when he finds you; and your place among engineers will be the very place you selected and worked to prepare yourself for, and it will be yours by right, and not by influence.



THE LINE ON WHICH A PLANER REVERSED.

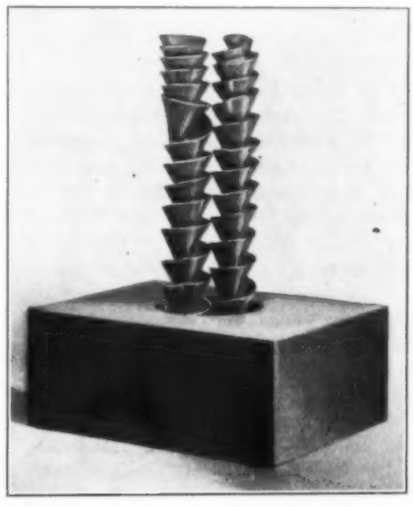
The Reversal of a Planer and the Grinding of a Drill.

It often happens that those in charge of exhibits at St. Louis have little things laid aside which they do not show to everyone who stops or asks a question, but only to "the elect"—*i. e.*, those whom they perceive know things about machine tools and machine shops and are capable of appreciating things the mere magnitude of which does not attract. Thus in the case of the exhibit of William Sellers & Co. a large and fine planer having new points is the prominent feature, and one notices readily enough that there is in it a radical departure from usual planer practise in leaving out the cross tie at the top of the housings and so forming and attaching the cross-rail as to make it perform the tying function; which of course it always does as near the work as possible. What is not noticed so readily is the new system of reversal by means of air-operated clutches. These we have previously referred to, and we now show in connection with it a photograph which tells its own tale about an incidental feature of the reversing mechanism—*i. e.*, how much more closely to a given point a planer is reversed by this means than by the shifting of belts. The photograph Fig. 1 shows a vertical surface first roughed off by one of the side heads and then, the stroke of the planer being shortened, a finishing tool was run over a part of the surface, as shown; the vertical line of demarkation between the roughed and the finished surfaces showing just how accurately the planer platen stopped at the end of the stroke throughout the cut. This was done on a 96-inch machine for planing 20 feet in length and with a return speed to the table of 80 feet per minute.

Another interesting specimen which they have in the exhibit shows the result of the use of the Sellers twist-drill grinding machine. The specimen consists of a block of steel 1⅝ inches thick, thru which a drill 1½ inches diameter has drilled a hole until the point of the drill just began to break thru. The drill was then stopped, loosened from the spindle of the machine and removed from the block by turning it backward, leaving the two curled chips still attached to the bottom of the hole and standing up above the surface of the block 3¾ inches or, altogether, about 5½ inches high. Of course we all know that in order to produce such chips there must be other things beside accurate grinding of the drill. There must be homogeneous metal in a condition of uniformity, and there must be steady driving and feeding of the drill, but with all these, no such chips will be produced in pairs unless the grinding is practically perfect.

Casting Iron or Steel in Metal Molds.

A United States patent recently issued to Charles Sp. Székely, Sr., assignor to the Metal Casting Company of America, upon the "Art of Casting Metals," has to do with the use of iron molds in which to cast articles of iron and steel, and with such a preparatory coating of the surface of the mold that the casting will not adhere to the mold and also will not be chilled or hardened. The following from the patent specification describes the process followed and gives a suggested composition for the wash or coating to be employed.



DRILL CHIPS STILL ATTACHED TO BOTTOM OF THE HOLE.

The specification says: "In order to successfully cast molten iron and steel in a metal mold and to keep the surfaces of the article cast from chilling, and also to obtain a casting of more compact and uniform texture than is usually obtained, certain conditions must be fulfilled, namely: First, the surface of the mold which is to come in contact with the molten metal must be coated with a wash spread uniformly over said surface; second, that this coating must be of such a nature that it will adhere to said surface, altho submitted to the influence of greatly varying temperatures; third, that this wash employed must leave a thin coating between the surface of the mold and the casting, which coating shall not act either upon the metal of the mold or the metal of the casting; fourth, that this wash must be composed of an inorganic substance which will produce said inert coating and a liquid substance of such consistency and quality as will hold the inorganic substance in suspension; fifth, that this liquid medium shall be inflammable from contact with the molten metal of the casting; sixth, that this liquid substance must not, however, be so volatile that its contact with the molten metal will generate gases too rapidly and cause by their generation and ignition explosions that would endanger the work and the workmen; seventh, that

this liquid substance or medium in volatilizing and burning shall generate sufficient gas to carry off with it the included gases of the molten metal. When these conditions are maintained, a casting will be produced in a metal mold whereof the surfaces will be soft and workable and the metal of uniform close texture and free from porosity or pitting. The casting may also be readily removed from the mold, as there will be no adhesions. For the inert coating body of the wash any inorganic substance may be used which has no chemical action on either the metal of the mold or the metal of the casting that will not decompose and combine with either under the conditions to which it is exposed in the mold. For the vehicle of said inorganic substance, said vehicle having the inflammable and gas-producing requisites, mineral oils of various kinds will serve. As an example of the wash, I prefer to employ the following: French chalk, in powder, 20 parts; kerosene, of over 150 flash test, 40 parts; paraffin oil, refined, 40 parts. These are mixed thoroughly together, the fluid ingredients holding the chalk in suspension. In carrying out the process of making a casting, the inner surfaces of the metal mold are evenly coated with the above compound or wash with the aid of a brush or any other suitable tool or implement, the mold closed and the molten iron or steel poured in. When the mold is opened, the casting may be readily removed, and when cooled it will be found to be smooth, free from porosity or blow-holes, without chill or surface hardening, and of uniform compact texture when its fracture is examined."

The use of iron cores with a protective coating which prevents them from chilling and hardening the casting was described in our columns a couple of years ago, and even then the core coating composition was being manufactured and sold by the foundry supply houses, so that it is not easy to see the novelty of the above invention. It may, however, carry some suggestion of improvement in the details of the process.

Some users of gasoline find it well to hang a bottle containing about a gallon of ammonia from the top of the tank or room containing the gasoline, by a string or fusible link, so that if the gasoline takes fire the bottle will fall and be broken, releasing the ammonia and promptly putting out the burning gasoline.

The moon moves with a mean velocity of 3,350 feet per second—not so very much faster than the projectiles of our best guns travel when on business. We may in time beat the moon in the race.

A bad habit many of us have of saying dirt when we mean earth. Earth in its normal position and functionally employed for the sustenance of man is as far from being dirt as anything can possibly be, and it should be spoken of with more respect by those of us who live upon it.

Conservatism in Engineering and in Education

BY HOWARD A. COOMBS.

The saying that "large bodies move slowly" is even more apt when applied to the collective mental attitude of people than when used to describe the motion of matter. An illustration of this inertia, which is familiar to us all, is found in the slowness of a large audience to appreciate a joke sprung without due and timely notice by a speaker or an actor. The remark, especially if the wit is delicate, requires time to sink in before the laughter becomes at all general. The wise speaker pauses a while after having uttered a witticism, in order that the inertia of the composite mind of his hearers may be overcome. So communities are hard to stir up to take any collective action, and nations even more so.

When you come to small subdivisions of the community and to private institutions like manufacturing establishments, you find less conservatism, at least new conditions are very much easier imposed. Many industrial plants are extremely (to coin a word) unconservative, the reason generally being that their operation is absolutely controlled by a few men of advanced ideas, who not only realize that it is to their advantage to institute reforms and novel means and methods, but are able to carry out their plans without the necessity of convincing a majority of their employees of the advisability of doing so.

The technical press has long since made us familiar with the conservative atmosphere pervading most British shops, and undoubtedly there is a good deal of truth in all of this. However, all the conservatism in the world is not monopolized by Englishmen, and indeed in many instances the English have been quicker to adopt new things than we—for instance, the bicycle, the automobile, the steam turbine and wireless telegraphy.

Now the matter of education is one which affects everybody more or less, and consequently there we should expect to find a good deal of conservatism, as in fact we do. Educational reformers are plentiful to-day, but since their acts are subject to the approval of the great public, or to a portion of the public in the case of private schools, the adoption of radically new ideas is a very slow affair. In education we inherit, together with our English cousins, the points of view and predjudices of the past centuries, and they are harder to change than the laws of the Medes and Persians.

Until recent years learning was entirely a thing apart from practical life, and it is so yet to a great extent, in this country at least as much so as in some others. There was originally an impassable gulf between the scientific man, the physicist, chemist or mathematician and the mechanic or artisan. The man who obtained his knowledge from books was considered infinitely superior to the man who worked with his hands, however skilled the latter might be. Yet the real work of the world has always been done by the manual laborer, and it is only within a comparatively short period that purely theoretical considerations have been applied to good purpose in the practical arts. Learning, so called, used to consist principally of Latin and Greek, and when mathematics was added, it was as pure science exclusively and not as applied science. When you think of it, it was a most curious conception of education, to put the study of dead languages, and other purely mental gymnastics, so far above the study of nature and of the best means for supplying man's wants. Imagine a party of such "educated" men thrown upon their own resources on an island cut off from the rest of the world. They might talk to each other in different languages, write poetry and solve geometrical problems, but they would be absolutely unfitted to extract from the earth and shape the materials necessary for their sustenance. Assuming their continuation, how many generations would it take before they would be able to provide themselves with a tithe of the objects and utensils in ordinary use?

I do not intend to decry the value to mankind of the discoveries and researches of the scientific men of the past. Admitting their tremendous results, when successfully applied in practise, the fact remains that only the smallest fraction of one per cent. of "learned" men have thus been able to benefit the race. However, the belief that, because a man has been to college or has received a special education in some line, he is necessarily better fitted for a responsible position and must excel the man who has learned his trade by working at it, still flourishes pertinaciously.

The modern plan, of combining the theoretical training with practical work, under conditions closely approximating actual commercial conditions, forms the best possible means of eradicating the erroneous belief that the man with book learning is necessarjly a better and more useful man than the artisan. The question of technical schools and trade schools is a live one at this time, and there appears to be no reason to doubt that the modern view of education will spread more and more until it eventually becomes practically universal.

Hardly a week passes without something appearing in the AMERICAN MACHINIST concerning the relative value in manufacturing businesses of the technically trained man and the practical man, and generally the former suffers in the comparison. Unless such a man has had the practical training as well, and preferably before his theoretical training, it is natural that he should suffer in such a comparison. How often a young man is sent to a technical college because his parents have read or heard it stated that

there is a great field for educated young men in electrical engineering, for example, and when he has completed his course he is told, "Well, now you have had a good education, we expect you to make a mark for yourself in the world." Perhaps he secures a job at $1.50 per day in the shop, where he finds himself at a great disadvantage in comparison with men younger than himself who have gained their experience right there.

It is not the ability to run a lathe or a planer on an ordinary job when everything is going smoothly that counts. It is the knack of knowing how to meet unforeseen emergencies and of remedying or taking advantage of existing conditions. A jobbing shop where all kinds of work and repairs have to be handled, often within a very limited time, such as that described by Mr. Osborne, offers splendid opportunities for developing a young man's self-reliance and knowledge.

I remember an instance where the uneducated practical man remedied conditions which had baffled the experts. An 80 horse-power, 500-volt electric motor had been installed to run a flouring mill in Pennsylvania. After running a short time and sparking badly the armature burned out and the builders furnished a new one, which, however, suffered the same fate. No one could determine what the trouble was, and as a forlorn hope a man was called in who ran a small electrical jobbing business, but who had never had even a common school education. He said he would fix it for them if they wanted him to. They told him to go ahead, and he had the armature taken out and then with a cold chisel and hammer chipped off the ends of the pole-pieces which nearly encircled the armature. That fixed it all right; the motor has run for years since without giving any further trouble. I don't suppose that man could set up as a consulting engineer, or get big fees for his opinions, but he had the valuable qualifications of being able to diagnose the case and the courage to prove his diagnosis correct.

Another case, in which a technical graduate fell down rather badly, occurred in a foundry and machine shop where I was employed at the time. The technical man, who was less than a year out of college, was given the job of connecting up to a 500-volt direct-current circuit, a motor to run a brick crusher, which had just been built by the company. All he had to do was to place the main switch and the starting rheostat and connect them to the line and to the motor. He made the mistake, however, of connecting both ends of the field circuit on the same side of the rheostat as the armature circuit, so that the field magnets received no current until the rheostat arm was moved to the first contact point. When all was ready he threw in the switch and grasped the hand-wheel of the rheostat, while an interested crowd of molders and Italian helpers stood around at a respectful distance. Jocularly exclaiming, "They're off —in a bunch!" he gave the wheel a turn. Then came a big flash, and the "man at the wheel" sat down rather suddenly on a convenient sand-heap. The worst of it was, he didn't know even then what the trouble was, and an electrician had to be called in who was uneducated in theory, but practical in fact.

A man cannot be a successful mechanical or electrical engineer without being a good mechanic or electrician, and he ought to be one of the latter before taking up the higher theoretical studies. The next best thing is to take up both lines concurrently, and that is what some schools aim to do, the Worcester Polytechnic Institute having been, I believe, the pioneer in this line. If the question as to why some material acts in a certain way, or as to the reason for a certain construction of mechanism comes up in the course of the regular duties of a young man in the shop, and he goes to work to find out, either by questioning others or consulting books, that piece of knowledge becomes irrevocably *his*, and he will never forget it. If he is the right sort, he will be interested to investigate the theory of and reasons for other things he comes in contact with in his work, and an education begun in that way must necessarily be of far greater value to himself and to others than the kind obtained by the young man who is sent to college to study subjects about the practical application of which he knows little or nothing, and who before he leaves is supposed to have mastered the entire subject, the higher portions of which he will probably never have a chance to apply, or will have forgotten long before he has the chance.

As Elbert Hubbard has said, "Work is for the worker." The man who prepares a treatise to read at a scientific gathering is the one who is benefited rather than his audience. An ounce of knowledge we go after ourselves because we are interested to know why certain things are so, or why certain actions take place, is worth a ton of knowledge we attempt to acquire because it is assigned us to study in the course we happen to be taking.

The same truth applies to every profession; at a law school a man loads his memory with a vast number of definitions, maxims and rules, the majority of which he forgets after he has passed the bar examination; but when he has to study up the law on a case of his own, what he learns he knows forever after. At the Harvard law school I understand the use of text books has been abolished, and all the lectures and study are based on actual cases. That is the solution of the problem of how to teach law at a school; but in that, as in engineering, a man gets far more out of his college course if he has previously had practical experience, whether in a law school or in a shop.

The way to do a great deal of the work which has to be done in this world can be learned only by practical experience. Take the handling of heavy weights for instance, such as moving safes and pianos, loading ships, etc.; the men whose services are sought to boss jobs of that kind are usually men whose practical experience, frequently acquired on ship-board, enables them to judge instinctively when the conditions are right. No amount of study of applied forces would fit a man to take charge of jobs like that; but, on the other hand, some study of the principles of mechanics might make the practically trained man still more valuable. In conclusion, I should say that all education beyond the rudiments taught to young children should, in order to be effective, follow actual work in the particular line which the student intends to follow, so that he will feel the need for the study and its usefulness, and take it up of his own accord for its own sake, instead of as a wearisome and disagreeable task.

The Mechanical Engineer of the Pacific Coast.

We keep pretty well to the front on this coast, notwithstanding the impediments One may go into any of our works out here and order a man-of-war, a wheelbarrow, a locomotive or an iron fence, and his order will be entered as a matter of commonplace practise. In the Eastern States they enjoy the advantages of organized production in specialized manufactures, and by the economy thus gained they relieve us of the great mass of what may be called engineering manufacture, leaving us the special and difficult part and all the risks. Still we manage to keep along, and sometimes we "carry coals to Newcastle." In ships of war, cable railways, hydraulic and mining apparatus of all kinds, plowing and hoisting machinery, we have a foremost place in respect to the world's practise. Not only in machines, but in men, we are well represented. If the members of the Society were withdrawn from the South African mines, it would cause a great change there. Our work is a little rough sometimes, and has to be, because of its cost to produce. A prominent manager in the East said to me, last year, in respect to a machine he was making, "It costs me more to sell that machine than it does to make it." This was true; the selling expense exceeded the labor account. We are not likely to do any of that kind of selling out here. It is a system of production that is not likely to endure and should not endure.—*John Richards at banquet of Tech. Soc. of Pacific Coast.*

The civil list of New York city contains the names of one engineer whose salary is $15,000, one at $12,000, two at $10,000, one at $8,000, four at $7,500, two at $7,000, five at $6,000, six at $5,000, four at $4,500, nineteen at $4,000, twelve at $3,500, and twenty-seven at $3,000; there being 117 getting $2,500 or more.

Letters From Practical Men.

That Jack-in-the-Box Speed-Changing Device.

Editor American Machinist:

Referring to A. L. De Leeuw's interesting article at page 1189, I enclose you a patent specification of mine of July 6, 1901, which covers, I believe, in principle exactly what Mr. De Leeuw describes and illustrates.

In designing mine I expected, on account of the small size of the spindle gear, to make the spindle movement unsteady and liable to cause chattering if applied to a lathe; for this reason I chose a worm and worm-wheel drive, but in the specification I mention the alternative of driving by pinion and gear.

I also had an idea at that time that a great economy of space and other advantages would result from placing all lathes in a shop crosswise, with the tail center toward the center of the shop, bringing the pulley on the worm shaft for driving the lathe within 5 or 6 feet of the side walls and driving direct from the main line. The number of lathes that could be operated in a given space would certainly be very great when arranged in this way, and long bars could be got in the lathes; but for hollow spindle work where the bar would require to project backward thru the spindle a difficulty would arise, and in such cases it would probably be best to reverse the position of the lathes, thus bringing the headstock ends toward the center of the shop.

I also had in view the use of this gear for motor bars and the like, and to that end provided a reverse. You will observe that with this gear an infinite range of speeds between prearranged limits is perfectly easy; in the one made I believe the range was 0 to 600 forward and 20 only, backwards.

It will be seen from the patent drawing that the well-known friction plate with a movable disk arranged to slide across its face was the means used to control the governing shaft, altho I thought, and mentioned in the specification, that the governing worm might be made of sufficient pitch to insure its turning unaided, and that its speed might be governed by making a pump of it or attaching a pump direct to it, and regulating the speed by simply reducing or increasing the delivery outlet, and I believe now that this would be a very good method of control.

After a great deal of thinking and designing, I built this machine in a first-class manner, and thoroughly cased in so that it would run in an oil bath. The selection of the pitch of the governing worm was most fortunate. During the construction everything worked out well, and I could not see how it could fail to give the variation of speeds, and if so, why it should not be of the very greatest value; being of box construction, it would wear well and require no attention beyond replenishing the oil occasionally, and the number of machines it could be applied to was enormous.

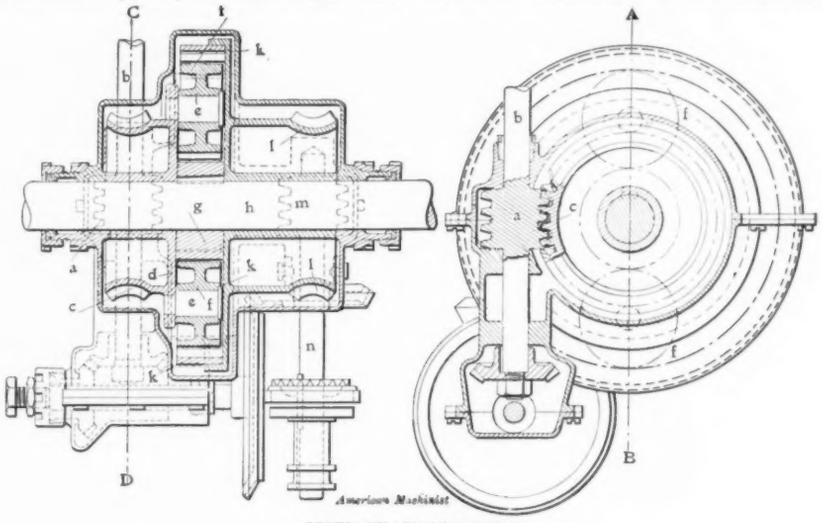
I remember well the day we completed it; after carefully putting together and well oiling it, we bolted it on a grinding machine table, put the grinder belt on the driving pulley of the gear, and found that we could control completely the governing shaft by simply taking hold of it with our fingers, producing spindle speeds of infinite gradation from 0 to 600. We then put the friction control device on and mounted the gear on a specially made stand and properly belted it with a view of making efficiency and durability tests, and up to this point the gear had proved the most satisfactory and encouraging of any of the many schemes it has been my lot to develop.

We next selected a very smart young draftsman from our staff to plan and rig up a suitable dynamometer and carry out the tests. Then began the disappointments, as trial after trial showed that we lost a very large part of our power especially at the slow speeds; in fact, we got little or no more effective torque at the low speeds than the high ones. We tested each individual part of the machine for faults and excessive friction, which, altho greater than we expected in some places, to no great extent accounted for the loss in the whole machine. After worrying on with tests for some time, I came to the conclusion that I had been deluded and that my variable gear partook of the nature of the slipping belt, or slipping-clutch contrivance sometimes used to transmit a certain speed or power only, and such speed to be less than the belt or driving part of the clutch.

In this gear there was a certain speed at which the whole mechanism rotated together without any movement of the wheels relative to each other, and at this speed we got a perfectly satisfactory spindle torque; when the spindle speed was increased we got less, which was as expected, but when we reduced the spindle speed the torque was not increased but remained the same as when the normal or above first mentioned speed was run, notwithstanding that we had geared down enormously, thus appearing to indicate that our machine gave us a perfect variation of speeds but from the normal speed down to the lowest, a quite unvarying torque showing that in reducing our speed we also enormously reduced the power transmitted to the spindle.

Thus, if we assume the normal speed at which all the parts revolved together and at which we transmitted all the power to the shaft to be 100 revolutions per minute, we got a given torque multiplied by 100, whereas at one revolution per minute we got the same torque multiplied by 1, or lost or wasted 99 per cent. of our power.

I do not believe these are the exact figures we obtained, but I believe they are what we should have got had our tests been sufficiently accurate. I have to admit that the subject is to me of the most absorbing interest, and I have been often tempted to make a further series of tests with the hope of discovering that some error was responsible for the results then obtained; this impulse was renewed when I read Mr. De Leeuw's article. If anyone can show me that there is the least probability of finding that to be the case, I will gladly mount this machine up again (I still have it) or I would put it at the disposal of anyone else so inclined, as my patent is now only four years old, and I would be very pleased to find I was mistaken in the opinion I formed of it.



SPEED-CHANGING DEVICE.

In the drawings herewith, *a* is the driving worm and *b* the driving shaft; *c* is the driving worm-wheel, loose on the shaft, and to which is attached disk *d* carrying studs *e e*, which in turn carry pinions *f f*; *g* is the driving gear keyed to the shaft or spindle *h*; *k* is an annular gear wheel meshing with pinions *f* and *f* and to which is fixed the second or retaining worm-wheel *l*, meshing with governing worm *m* on shaft *n*. The driving or belt pulley goes on shaft *b* and the governing disk on shaft *n*; all other parts are clearly shown and will, I think, be easily understood.

London, Eng. HARVEY E. BROWN.

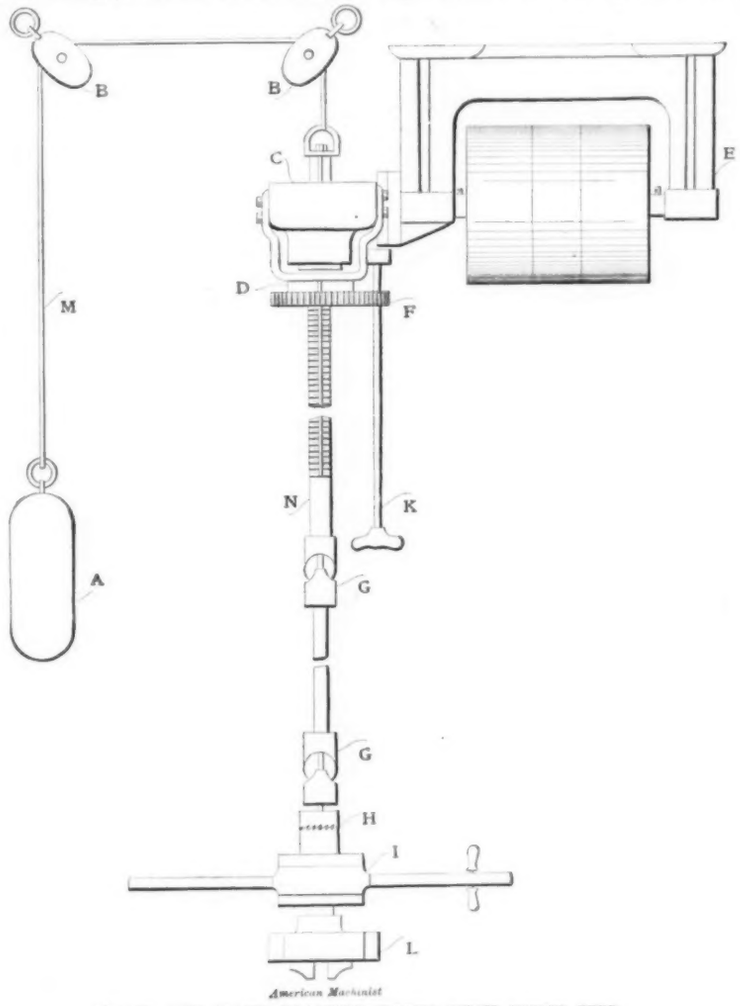
Power and Hand Reaming Device With Power Feed.

Editor American Machinist:

The accompanying drawing represents a hand-reaming device with power feed for reaming all classes of work commonly done by hand. The spindle *N* has a traverse feed of about 4 feet, also has a thread chased upon it of four to the inch, right hand. This spindle *N* passes thru a worm gear connected to the countershaft at right angles. This is driven by a three-pitch worm which makes a ratio of 30 to 1. This countershaft is placed overhead on the ceiling. *B B* represents two pulley blocks thru which rope *M* is passed. At one end of the rope is the counterbalance weight *A;* at the other end it is connected to the spindle by a swivel and counterbalances the weight of the spindle. Spindle *N* also has a ⅜-inch spline the full length. *D* represents two half-nuts which engage or disengage the thread of the spindle *N*. This movement is operated by a 45-tooth 8-pitch gear with two cam slots cut into the side, giving each half of the nut a movement of about ⅜ inch. This is operated by the workman by turning lever *K* right or left. *F* shows a small pinion attached to lever *K* which engages into the 45-tooth gear. *G G* represents two universal joints connected together with a piece of cold-rolled iron about 2 feet long, so that it will give all the motion required. It also compensates so that if the work is placed out of center with the spindle or is standing out of square, causes no deviation in the size of the hole reamed at either end.

H represents a saw-tooth clutch cut right-handed; this, having a keyway in it, can slip up and down the shaft it is on, so when the operator starts his reamer in a piece of work, allows him to turn without using the power, which is at times necessary. *I* represents a loose handle which can be tightened same as tap wrench, or left loose to steady the reamer by the operator. *L* represents a 7-inch two-jawed body chuck for gripping all sizes of squares.

Two of these devices are working to great advantage in our shop, reaming our work just as well as by the old way—having workman to do it by hand. The output also is far greater. This device runs 15 revolutions per minute.



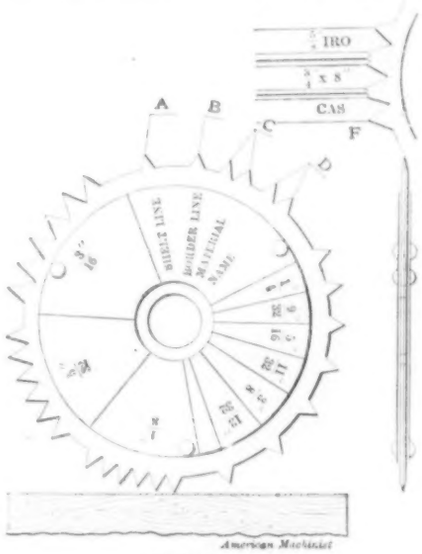
POWER AND HAND REAMING DEVICE WITH POWER FEED.

EDWARD C. CONNERS.

A Lettering Gage.

Editor American Machinist:

At page 1410 I notice a letter entitled "A Lettering Gage," and would like to describe one I saw used in an office about two years ago. I think our friend, Mr. Crispen, will discard his and adopt this. It is made of machinery or tool steel about 1-32 inch thick. A paper disk is shellacked on each side, marked as desired with waterproof ink and then shellacked on the outside to keep clean. The three escutcheon pins are not to keep the paper in



A LETTERING GAGE.

place, but to make it easy to pick up. It is universal with the exception of the portion *A B C D*, which varies with the practise of every office. It is useful for lettering and for making tables. To use the gage for marking a drawing where the paper or cloth is cut to size, place *A* on the edge of the sheet and mark off the distance from *A* to *B* by pressing lightly on the paper, except at the bottom of the sheet where you allow the gage to rotate between the thumb and forefinger until you have *B, C* and *D* marked off. For ordinary work, as lettering on detail sheets, use the ⅛ or 5-32 inch space as you desire. For table work, repeat until you have the sheet ruled off. If you do much table work, you can make the gage with first a small space, then the hight of the letter and then the small space again, as shown at *F*. The light lines are pencil lines and the heavy are those that space the sheet off. The beauty of this gage is that it does not punch a hole in the paper, but makes an impression in it which can be readily seen. The gage is about 2½ inches outside diameter, with a ⅜-inch hole in the center.

HERMAN JONSON.

Dixie's Piston Rod?

Editor American Machinist:

My hereditary enemy, "Yank," at page 1404, tells the readers of the AMERICAN MACHINIST the same thing that I told them at page 1238, but no more. *I* know *what* cut the rod. What I want to know is: "How can soft white metal cut moderately hard steel?"

My sea experience dates back only twenty years, so of course I do not remember that far-off time referred to, "the days

of excessive cylinder lubrication"; and you don't get oil or any other stores on a British tramp steamer in *excessive* quantities.

I do remember that I swabbed the rods, including the I. P. and L. P. tail rods every twenty minutes. What the Second did on his watch, whether he swabbed the rods or oiled the ventilators, has nothing to do with the question. *How* can soft white metal cut steel? DIXIE.

A Single and Simple Molding Machine Instead of Two.

Editor American Machinist:

At page 1240 you published an example of machine molding as applied to a casting of such depth that, to form the drag

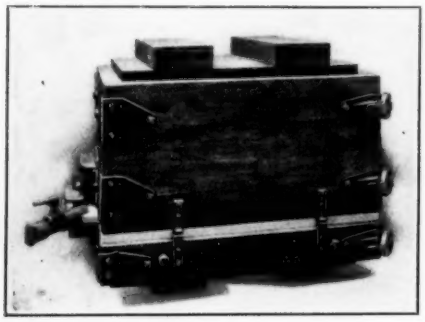


FIG. 1. A COMPLETE MOLDING MACHINE.

half of the mold, it is necessary to invert the pattern before drawing it. The method described involved the use of two machines: one a hand ramming stripping plate machine, and the other what is known as a rock-over machine. It occurs to me that you may be interested in a description of an apparatus for doing the same work on one machine, without the use of stripping plates and employing the original pattern without change from its condition when used loose on the bench or floor. The mechanism concerned in the drawing of the pattern is so simple that I hesitate to call it a machine; and yet, as it is really as complete a hand ramming machine as any, and a great saver of pattern cost, perhaps I may be allowed to dignify it with that title.

Fig. 1 shows this machine as it appears after the mold has been rammed, and when all is finished except drawing the pattern. It would appear to anyone as an ordinary snap flask; yet, in fact, the essential parts of the machine are all in view. There will be noticed in the joint between the cope and the drag a thin plate. This is the edge of a vibrator frame, ½ inch thick and exactly as wide all around as the thickness of the walls of the snap flask. This frame is guided inside the drag pins of the snap flask, while the cope is guided on the outside of the pins. The vibrator is seen with its connection for the air attached to the frame at the left hand, and the apparatus as a whole is called a vibrator frame molding machine.

Fig. 2 shows the machine separated into its working parts, of which there are only four, including the match for forming the joint of the drag mold, which is not included in the figure. In actual practise, even on work as deep as this, which is a water pan for a hot-air heater, probably two-thirds of the ramming is done by power; and for this purpose the machine, as I have called it, is operated on the platen of a plain power ramming machine, just as it would be on the bench, the head of the power rammer being swung up into position and air pressure applied when the power ramming is done.

To a molder the operation of this machine is probably evident from the photographs without further explanation. The pattern, handled always only by the frame to which it is attached, and in which condition it may be hung on a peg on the wall, is first placed in the match or "odd-side," and the drag flask is placed over it, guided to position by its pins sliding over the pins on the vibrator frame which carries the pattern. Sand is then thrown in, and about two blows with the butt of a shovel are delivered in the deep center of the hollow pattern. A bottom board which fits inside the drag flask is then placed so that it will ram in, and it is then forced in by the power rammer, thus completing the ramming of the drag half of the mold. The operator then draws the match and drag half of the mold toward him and rolls the whole thing over the edge of the platen of the power rammer just as the bench molder would over the edge of the bench. The match is then removed and the cope flask is placed in position, sliding over the pins of the drag flask, as above described. Parting sand is thrown in to separate the sand surfaces of the cope and drag, thus forming the joint of the mold. A properly shaped flat plug for forming the sprue thru which the mold is to be poured is placed on dowels on the pattern and held in position by tucking a little sand around it. Around this sprue-forming plug is placed a board (on the under side of which is a boss to form the pouring basin) to ram in the top of the cope flask, after the edges only of the cope have been tucked with the butt of the shovel, and a relatively light pressure of the power rammer completes the ramming of the mold.

Just below the platen of the power rammer is a valve for admitting air to the vibrator, and the operator, pressing his knee against this, starts the vibrator while he lifts the cope off the platen and lays it on one side. He then once more operates the starting valve with his knee and lifts the pattern by its vibrating frame away from the drag, the pattern guide, formed, as above mentioned, by the pins of the vibrator frame sliding over the pins of the drag.

Hanging the vibrator frame and pattern on a peg or laying it on a shelf, the operator then closes his cope on the drag and opens the snap flask, leaving the bulk of sand forming the mold entirely exposed.

It will at once be apparent that the points at which the pattern is attached to the vibrator frame in the molding form openings thru which the fluid iron would run out were it not stopped. The operator, therefore, with a quick motion of the fingers presses the sand from the outside into these openings and then protects the finished snap mold against the pressure of the iron by placing over it what is called a slip or jacket, ordinarily of wood.

To the molder it will be at once apparent that a mold thus formed from a pattern in one piece instead of from a pattern in two parts and, worst of all, operated by two separate and different machines, is much more dependable for thickness, match, etc., as the inevitable wear and tear goes on. E. H. MUMFORD.

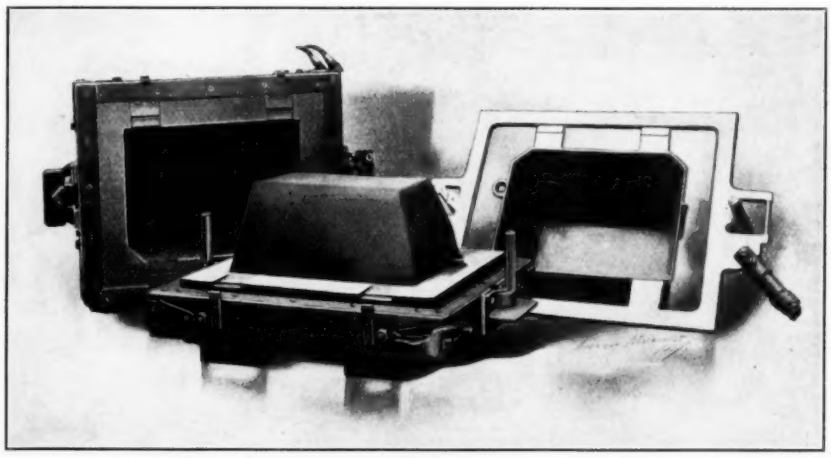


FIG. 2. THE SEPARATED PARTS OF THE MOLDING MACHINE.

Electric Service on Main Line Roads.

Editor American Machinist:

In your article on the General Electric Company's compensated railway motor, at page 1285, after a good description of this very creditable machine you indulge in prophecies of the possibility of the electric motor competing with the steam locomotive for main line work.

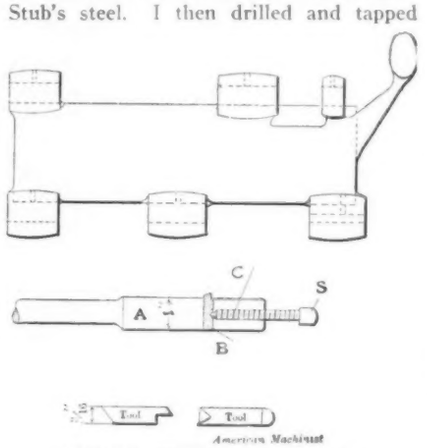
In this connection may I ask if success-

ful railroading does not consist of something more than providing sufficient power to haul the trains? Is not this business sufficiently hazardous to trainmen and passengers without having a high-tension trolley wire suspended over their trains in such a way as to be almost sure of coming down on top of every wreck? RIGGS.

Tool for Cutting Oil Grooves.

Editor American Machinist:

I often have to work on machine parts like the illustration. The holes in the hubs are 1 inch, and oil grooves must be chipped in every hole. To do this with a common oil-groove chisel is a hard job and the edges of the holes are spoiled, especially those in the middle of the piece, because the other hubs or the casting will be in the way. I took a piece of 1-inch stock, drilled a 3-16 inch hole *B* in it to take the tool *T*, which I made from 3-16 Stub's steel. I then drilled and tapped



TOOL FOR CUTTING OIL GROOVES.

another hole *C* for the pointed screw *S*. The bar *A* is flatted a little from the tool to the end, to allow the chips to come out. A center line is scribed on the same part, which can be seen thru the oil hole and allows one to see that the groove is made straight. Having the bar in the right position in the hole, it is easy to force the tool out by turning the screw, then I gave light blows at the other end of the bar. With two cuts I had a nice oil groove. The work is done quickly and well, while it took me less than an hour to make the tool.

C. B.

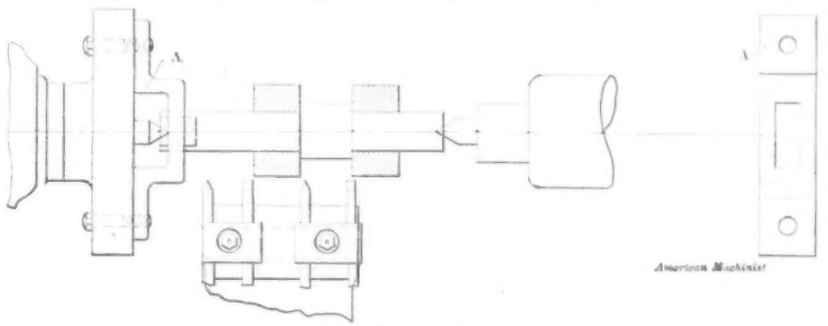
Machining Collars for Shafting.

Editor American Machinist:

At page 1413 Frank B. Kleinhans illustrates a method of machining collars, and states that it is necessary that they shall run true. While the method shown may machine collars to answer many practical purposes, it is obvious from the way he faces them that they are not exactly true or parallel, therefore when so many of them are clamped on a mandrel the latter will be sprung badly out of truth.

The sketch shows a method of machining the outside diameter of such collars on an engine lathe, using two mandrels in connection with an arbor press and forcing the collars on one mandrel while the cut is going over the other.

The mandrel is milled on one end to fit loosely in the driver which is clamped on the face-plate of the lathe. The enlarged portion of the mandrel between the two collars acts as a spacer, keeping the collars apart the required distance relative to the tools. The collars are pressed on from opposite ends; as there is very little stock removed, they need not be very tight.



TURNING COLLARS.

The four tools, roughing and finishing, are set with parallels underneath to the proper hight and secured to the rest with two bolts and ordinary clamps.

W. J. M.

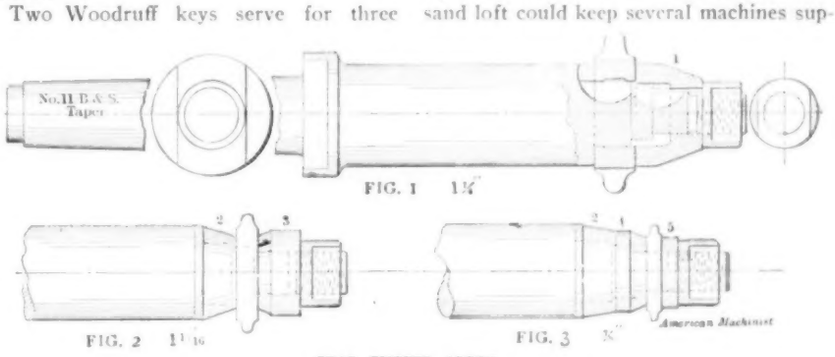
Gear-Cutter Arbor.

Editor American Machinist:

To those who are using universal milling machines for cutting gears of many pitches, the arbor and washers or collars, as here shown, if made and tried, will be found handy and economical.

Fig. 1 shows the arbor as arranged for those having 1¼-inch holes in cutters; Fig. 2, those with 1 1-16 inch holes; Fig. 3, those with ⅞-inch holes. It is adapted for the entire set of Brown & Sharpe standard gear cutters, including the stocking cutters.

Two Woodruff keys serve for three



GEAR CUTTER ARBOR.

sizes. This style arbor saves the time taken up in changing arbors for each size cutter hole. H. E. B.

Giving the Molding Machine a Chance.

Editor American Machinist:

Many foundry proprietors have an idea that a molding machine ought to make as big a gain for the foundry as a turret lathe can for the machine shop. They do not find it so. The difficult circumstances in which a molding machine is placed make it somewhat of an uncertainty. More profit could be got out of a machine if the foundrymen would adopt a different system of working the different parts of the foundry in conjunction with the machines. A pneumatic sieve, a pneumatic hoist, and a trolley to run it around are already adopted by many foundrymen. These three are only a few of the devices that can be used to cheapen the output. They should be worked on a larger scale and the new devices adopted that could be got up to work with them.

For instance, suppose a system could be devised for rapidly handling the sand before the molding and after the molds are poured, and by means of which a few laborers could in a short time put all of the sand in use back in position again for the machine molders. As more molds would thus be made, I would suggest that something might be done to save valuable floor space. This can be obtained to a degree by removing the sand heap from the floor around the machine. I would suggest a sand loft above the machines and over the windows of the foundry and the sand fed to the machine by means of a hopper, this hopper to be divided into two parts: one for the cope and one for the drag. By this means one man stationed in the sand loft could keep several machines supplied with sand and enable the men operating the machine to put up more work and be in better condition to pour off.

To get the sand off the floor quickly and have it in a position where it could be readily and cheaply placed in the sand loft, I suggest a cellar under each molders' floor, and the floor where the molds are set should be an iron grating large enough to let the sand drop thru when molds are dumped. A gangway could be left from the main center gangway to each machine.

up which the men would bring the iron. Under this iron grating could be suspended a number of large sieves into which the sand would drop and under each sieve could be a large hopper converging to a small trap door. The sand from the sieve would drop into the hopper and its slanting sides would bring it over the slide. Under this hopper slide, on the cellar floor, could be a narrow-gage railway running lengthwise of the mold floor, a dumping car could be installed and the car could be run under each hopper to receive its contents of sand, and from there it could be taken to the elevator, which would raise it to the sand loft. One elevator would do for all the floors. This is one of the many ways by which to lower the cost and produce more work. With such an arrangement a molding machine would be indispensable, and after it was once installed it would only be a short time before it paid for itself. A foundry equipped with such a system as I suggest could readily bid low enough to get many contracts for work that they could not get under the old method of working. In the near future some enterprising foundrymen will do this very thing and make a success of it.

R. O. N.

Machine for Grinding Gas Engine Piston Rings and Cams.

Editor American Machinist:

Figs. 1 and 2 show a machine that we built some time ago for grinding cast-steel cams that operate the mixer and exhaust valves of a gas engine. It is also used for grinding piston rings, and, in fact, is shown with a ring in position to be ground. Before this machine was built the cams were filed, it usually taking a man a half day to file one to shape; besides the operation was very severe on files. With this machine we grind four of the cams in an hour, thereby effecting quite a saving.

As will be seen, the machine is belt driven, and the carriage *A* reciprocated thru the worms and worm gears *B* and the cam *C*. The piece to be ground is driven in the same direction as the main spindle, thru the pulley *D* on shaft *E* and pulley *F* on the work spindle, the belt making a twist to turn the work in the right direction. The trunnion *G* on the carriage, following the groove in the cam *C*, gives the carriage a smooth, even motion from side to side, thereby bringing all the surface of the work to be ground in contact with the emery wheel. In grinding cams the work spindle *H* carries a finished cam at *I* (instead of the plain disk shown, which is used when grinding rings) which rolls on the adjusting wheel *J*, thus allowing only the proper amount to be ground off the piece. The carriage can be swung on the spindle *K* by pulling out on the handle *L* as far as the chain *M* will allow. This chain and the weight *N* tend to keep the work in contact with the emery wheel. The emery dust falls thru the spout *O*.

In getting the piston rings ready for grinding the ring casting is first rough turned on the lathe and the rings cut off the proper width. A piece is then cut out on a 45-degree angle, as shown at *P*, Fig. 3. Now the ring holder, Fig. 4, is brought into use by placing the centering piece, Fig. 5, in the holder, then springing the ring together and placing it in the holder on top of the centering piece. The other centering piece shown at Fig. 6 is now placed on top of the piston ring as in Fig. 7, which shows the holder, piston ring and centering pieces all together. The whole device is now placed on the work spindle and securely bolted together. Then a slight tap on the side of the holder with a hammer loosens it and the ring is centered and ready to grind, as shown in Fig. 1, also in section at Fig. 8. The disk *I* on the carriage spindle is the exact diameter of the finished ring; there can be none under size, for the disk then rolls on the adjusting wheel. When finished the ring is taken out and the same operation gone thru again for another. Heretofore the rings have been filed to make perfect fits in the cylinder, but this device for centering the ring and grinding is a great saver of time and the rings machined in this manner make a more perfect fit.

A. J. BRUTSCHE.

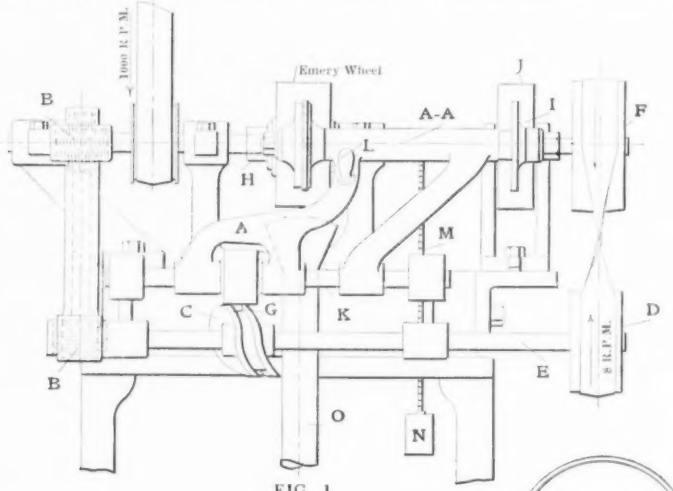


FIG. 1

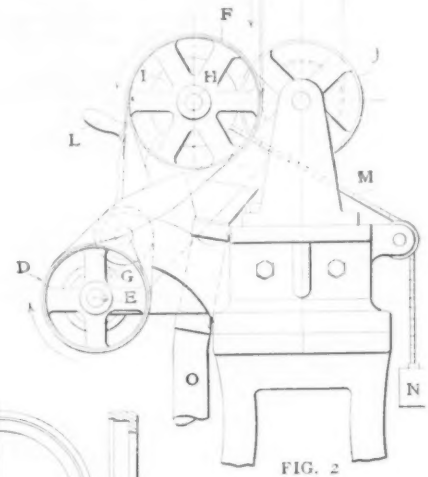


FIG. 2

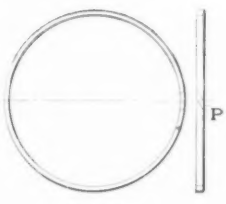


FIG. 3

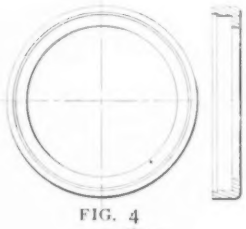


FIG. 4

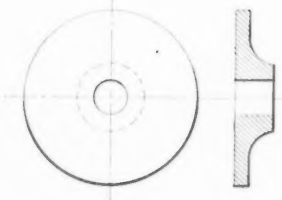


FIG. 5

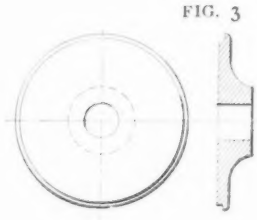


FIG. 6

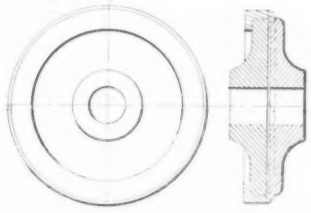


FIG. 7

FIG. 8

American Machinist

MACHINE FOR GRINDING GAS ENGINE PISTON RINGS AND CAMS.

Some Applications of High-Speed Steel.

Editor American Machinist:

When Novo steel came into use, I thought I would send for a bar and try it.

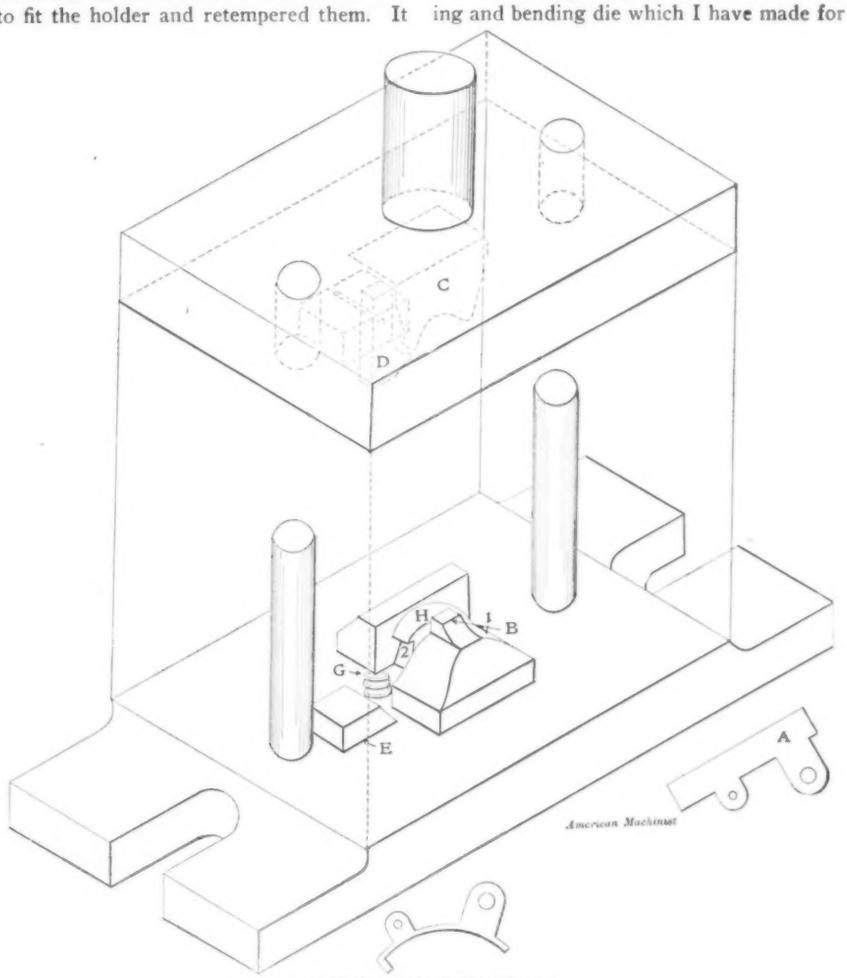
I first tried it in Armstrong tool-holders, where it showed up all right; I then looked for more opportunities to secure the benefits of its high-speed qualities. At this time I had a good many boiler heads to drill and cut holes in for the various sizes of tubes. Before I had used the high-speed steel I had designed a tube hole cutter with inserted steel cutters which I made of good French steel. This tool had a yielding center with a coil spring behind it, this dispensing with the drilling of small holes for the pilot of the cutter. These boiler heads were 6 feet diameter and ½ inch thick; they had seventy 4-inch holes for tubes cut from the solid and about thirty 15-16 holes for staybolts, and in using the French steel cutters the time consumed was twelve hours. The work was done on a 5-foot radial press. Four cutters were used to the tool. The lubricant used was a mixture of lard and engine oils—about half and half; I could not do as well with any soap mixture. I concluded to try Novo steel in this tool, so annealed the steel and milled the cutters to fit the holder and retempered them. It may be interesting to some to know how they were annealed. The cutters were about 6 inches long. I took a 2-inch nipple about 8 inches long, and two caps, put the four cutters in the nipple and screwed the caps on tight and brought the whole thing to a bright red and kept it so until the cutters inside had a chance to get to the same heat. It was then put in the center of a barrel of dry ashes. When taken out the next day the cutters machined as nicely as annealed tool steel. In hardening I hardened only about 1½ inches of the end by heating and putting in a mild air blast. When this tool was put to work it fulfilled all expectations. Having in the meantime ordered some drills of the same high-speed steel, I used one for the staybolt holes. In using the two Novo tools the time was cut down to 7 hours, the 4-inch holes being cut in 5 hours, which was at the rate of 14 per hour, and this could have been bettered if the press had had more power, as the boy could stop the press and not injure the cutters. I was able to cut out three heads, or a total of 210 holes, without sharpening the cutters.

R. P. SAFELY.

Forming and Bending Die for Electric Contact Clips.

Editor American Machinist:

The drawing shows a combination forming and bending die which I have made for shaping the blank *A*. This blank is placed on the die block *H*, the ears projecting on each side of stationary block *B*. Die block *H* has a vertical movement and is held up to the position shown by springs *G*. As the punch-holder descends over the guide pins in the die-plate, punch part *C* presses the blank on the curved surface of *H* and then *H* is forced downward until the ears are bent at right angles by coming in contact with the curved surfaces 1 and 2. When the downward movement is nearly completed punch part *D* strikes the bevel edge of block *E*. This moves *D* against the end of the blank and bends it as shown in the finished blank *F*. After the blank is thus finished a spring withdraws *D* from the die-block *H* as the punch rises. The finished pieces are used three together as electric contact clips on a two-speed switch for an alternating current ceiling fan. The die has given entire satisfaction and was not expensive to make.



A FORMING AND BENDING DIE.

Jos. H. BLAIR.

An Aluminum Fountain Pen.

Editor American Machinist:

One of our men broke the barrel of his fountain pen. By "barrel" I mean the hard rubber tube which contains the ink. The pen was a good one, the point was smooth and just suited his style. The ink flowed freely, yet was never known to blot and when carried in the vest pocket it never leaked. On the whole, the man prized the pen so much that he preferred to have it repaired rather than purchase a new one. In fact, he preferred to repair it himself rather than risk sending it to the manufacturer. He had no hard rubber, but being a skillful metal worker he made a new barrel out of aluminum, threaded it and screwed in the pen point so that it did not leak. It was a swell-looking job—white aluminum barrel, black rubber tips and a shining gold pen. He filled it with ink and it wrote beautifully. He put it in his pocket and carried it home to show to his wife, but when he took it out of his pocket he found that the pen had leaked until it had penetrated thru to his "manly bosom." He remembered that he had filled it from a cool bottle and thought that the heat from his body might have expanded the fluid until it overflowed. He left the bottle beside the pen in a warm room for a number of hours, then filled the pen and stood it up in a corner over night. In the morning the pen stood in a puddle of ink which was still flowing out of the little hole in the cap. He plugged up the hole with wax and the cap filled with ink. Thinking it needed more ventilation, he dug out the wax and even drilled more holes in the cap. The ink leaked thru them all. He removed the cap, unscrewed the pen-holder and filled the aluminum tube nearly full of good, fresh ink, and watched it. In a short time the ink visibly arose until it *stood up* some little distance above the top of the tube, finally frothed over and dribbled down the side. It was too literally a "fountain" pen; it was a geyser! The owner was obliged to cast it aside and hunt for an explanation of its strange action. Aluminum is commonly believed to be less affected by ordinary chemicals than most other metals, and it is not supposed

that a good make of writing ink would contain chemicals which would attack any metal in so violent a manner. Was it because of impurities in the aluminum? Was it due to expansion by heat, or was the capillary attraction in an aluminum tube different from that in hard rubber, or did the ink set up some chemical action in contact with the metal which should cause the fluid to boil over? W. H. S.

Forging Shafts With Large Hole in the Center Tapering to Each End.

Editor American Machinist:

With hollow shafts of large diameter I was at a loss to know how these shafts

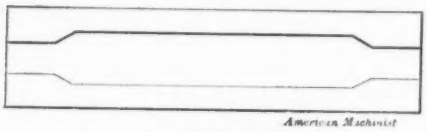


FIG. 1. HOLLOW SHAFT.

were bored. I don't remember the exact proportions, but a 16-inch shaft will have a hole, say, 6 inches in diameter for a few feet at each end, which will taper into a hole 9 inches in diameter in the center of the shaft. Fig. 1 shows a section of one of these shafts, such as are used in our large men-of-war.

The forging is made as at Fig. 2, and after boring straight thru the largest diameter the ends are put under the hammer or forging machine and brought down to the diameter of the rest of the shaft. This of course reduces the size of the hole at the ends and leaves the shafts reinforced where the couplings are shrunk on.

DIXIE.

Drill Jigs.

Editor American Machinist:

Fig. 1 crudely illustrates an effective holding device for a jig. The jig in question is used when drilling pin-holes thru two adjacent hubs and thru the shaft on which they are to be mounted.

For definite reasons the hubs are so close one to the other that it was difficult to provide rapid and effective means for

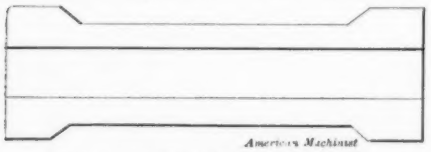


FIG. 2. THE FORGING BORED OUT.

securing the pieces on the shaft in correct relation for drilling. The jig was devised to meet the conditions.

A substantial casting was made with abutments to support the shaft, which latter is shouldered at one end. On top of the abutments were secured V-blocks *A* and *B* in which the shaft was laid. A spring *C* was attached to bear against the end of the shaft and press the shoulder *D* against the V-block *A*, the shoulder *D* being the gage point from which the pin-holes are located.

Before the shaft is placed in the V's the two members *E* and *F* are placed upon it. Their positions are controlled by the V's and they therefore require a device to separate them and push and hold them against the V's.

This device is the two-plate lever *G*, made just thick enough to enter between the two members *E* and *F*, with due allowance for any ordinary variation in their length. Between the plates of the lever *G* is a sliding wedge *H*. When the lever is locked down by the handle *I*, the wedge *H* presses on the shaft to hold it in position and coincidently spreads the sides of the lever, pressing them against the members *E* and *F* and forcing them to their positions for drilling.

For purposes of clearness the bushings and their supports have been omitted from the sketches, the purpose being solely to show the clamping arrangement. Under some conditions it would obviously be essential to provide a post or other support directly beneath the clamping wedge *H* to prevent springing the shaft, but as used, no post was required.

Another assembling jig is shown in Fig. 2. In this case the lever *K* is to be assembled to the shaft *L*, and the function of

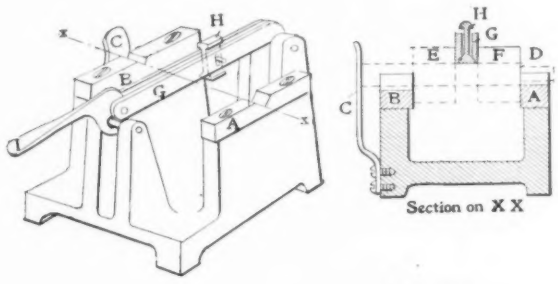


FIG. 1. DRILL JIGS.

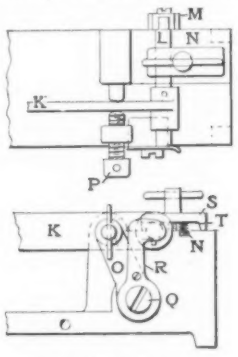


FIG. 2.

the jig is to drill the hole thru the two for a taper pin. As in the previous instance, the shaft *L* is shouldered, and the shoulder abuts against a small V-block *M*, the shaft itself being supported in a larger V-block *N*.

The lever *K*, slipped upon the shaft, is held by the same gage points as when drilled for the shaft hole. For clamping, a swinging arm *O* is employed, carrying a clamp screw *P*, the arm being fulcrumed on the stud *Q*. Attached to the hub of *O* is the spring *R*, which, when the arm is swung up to clamp the lever *K*, acts on the shaft *L* and pushes it against its gage point, the V-block *M*. Then the clamp *S* is tightened upon the shaft and the pieces are ready to drill.

When the pieces are to be removed from the jig, the clamp *S* is loosened, the spring *T* raising it from the shaft; the screw *P* is loosened and the arm *O* swung down, carrying the spring *R* away from the shaft and leaving it free to be withdrawn.

As in the first instance, no drilling bushings are shown, they being of usual form and their presence tending to confuse the sketches. J. I. G.

The Modern Machine Shop Apprentice.

Editor American Machinist:

The article by Chas. H. Thomas, at page 1276, "The Foundry Apprentice as Seen in One Shop," applies in some respects to machine shop apprentices also. If we go back twenty to twenty-five years, it will appear that the boys then had opportunities for learning the trade more thoroughly, altho to-day they have better tools to learn on.

Years ago, the apprentice who was hired to learn the trade began with the broom and shovel. In the course of time, between running errands and sweeping, he was promoted to the bolt cutter to be initiated into the mysteries of cutting threads and tapping nuts. After a siege of several months of this, he would sigh (and sometimes kick) for an opportunity to run the drill press, and would get it; then would follow a course on the lathe, planer, shaper, and finally on the floor and vise. Now, that boy got a fairly good acquaintance with the different tools, starting with roughing-out work and in time doing the finishing and fitting. If the lathe he was working on had no index for cutting threads, as often was the case, he was taught, or somehow learned, how to figure out the gears for himself.

One would think that the boys of the present time would turn out to be better mechanics than those who served their time twenty-five or thirty years ago; but from my observations in many different shops in the past decade, I do not think so. I do not wish to be misunderstood: there are thousands of skilled men in their particular lines of work in the shops, but all-around mechanics are few and far between.

In a certain large tool plant, manufacturing machine tools which are a credit to them and which can be relied on, they demand first-class work from their men and give the apprentices opporunities to work their way thru the shop on all the tools, finishing their time on the floor. Now, here we have a plant that is modern and up to date in every respect, and one would think that a boy when out of his time at this shop, a full-fledged mechanic, would be a valuable addition to another plant. When he starts to work in another shop, however, he finds every-

thing very different. He is told, for instance, to make a driving fit of a certain piece, and finds that it turns out to be a sliding fit. Right here it appears wherein the apprentice of years ago and a great many of those of to-day differ. The one was taught the whole operation of how to caliper the hole in the crank, and set his outsides correctly for turning the shaft whether it had to be either a driving or a shrink fit; the other—well, we will go back to the shop where he served his time and watch how he calipered his work to make a driving fit. He goes to the toolroom and gets a nice, new standard mandrel, the size of the bore of the crank. Now, as it has a slight taper to it, he drives it gently in to the point considered a driving fit, marks it, drives it out and calipers it at that point, turns the shaft so that the touch of the caliper is the same as at the line on the mandrel, and the result is a nice driving fit.

Now where this young journeyman had just finished his time he would be considered a good workman, turning out many feet of shafting every day, never missing a driving fit, boring a hole ½ inch taper to the foot or somewhere near it, then finishing up with that nice, well-kept, half-inch-to-the-foot reamer, or turning taper pins with the taper attachment, and he would come to the conclusion that he is too good a man for this other shop and is not appreciated financially. He will break the news to his foreman that he will leave for other fields where he will be appreciated. He concludes that a smaller shop in some other town will be about the right place to strike for and he will install himself there and surprise the natives with his superior ways of getting out work. He is asked if he ever ran a shafting lathe. He tells them of how many feet of a certain size he has turned out a day, and forthwith he is introduced to that long lathe in the corner, whose "modern" equipments comprise a headstock, tailstock and carriage, not forgetting the steady-rest with two gray-iron and one wrought-iron jaws. After wrestling with one length of shafting for the best part of the day, he complains to the foreman about the lathe and suggests that if he had the devices that so-and-so had on the lathe he ran, what surprising results there would have been that day. At the same time he does a little thinking about what the foreman told him of Brown (who runs the lathe occasionally) turning out three lengths of that same size in one day, and concludes that Brown must have served his time on that lathe and has some magic attachments hidden away which he is too selfish to tell him about. When the foreman calipers the shaft and finds it above size, he says with an injured air that he was accustomed to using sizing calipers. A similar experience accompanies the boring of a taper hole where he has no half-inch-to-the-foot taper reamer and must depend on his skill to get a perfect fit.

The above incidents are only too possible with a great many of our young journeymen just graduated from their apprenticeship and who have been accustomed to go to the toolroom and find standard inside and outside calipers, flat gages, sizing plugs and collars, a tool dresser to dress his tools, a tool grinder in the toolroom, and, in a number of our shops to day, a man who attends to the lacing of belts.

In a great many respects, it is better for the apprentice that he has failed to get the opportunity to serve his time in the large modern plant and has been compelled to work in a smaller shop, where the apprentice has to help himself. S. S.

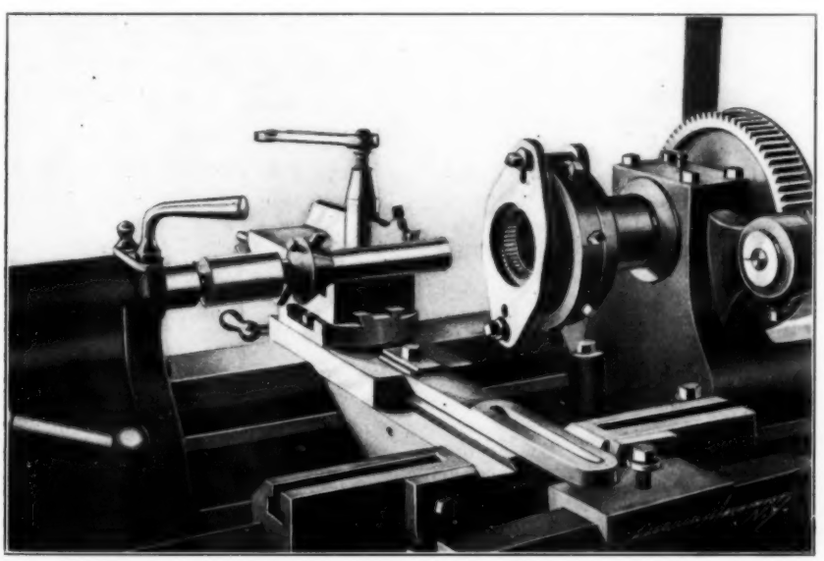


FIG. 1. COMMUTATOR TOOLS IN PLACE.

Boring Small Commutators.

Editor American Machinist:

At page 1126, Vol. 26, I described a method of making small commutators having special reference to the lining up of the bars. A short time later (at page 1329) a letter appeared by B. M. Mitchell giving the method he uses. The main point of difference seems to lie in the style of clamping ring used to hold the bars tightly together while boring. It is not quite clear in his method of chucking whether he grasps the ring in the chuck or the commutator itself.

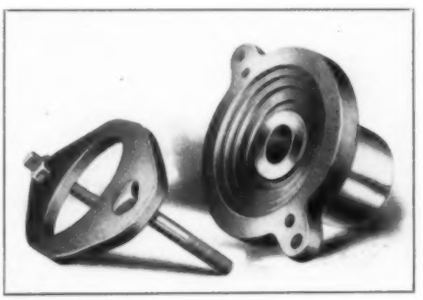


FIG. 2. THE CHUCK AND CLAMP.

At the time of my previous letter we were using a universal chuck and boring in the ordinary way. As I stated, there was a difficulty in holding the commutator sufficiently rigid to allow a good cut and to insure it from being torn from the chuck by the tool digging in. It occurred to me that if the commutator could be chucked very securely and the cutting tool were well supoprted, the internal dovetail form could be bored with a single cut. The chuck and boring tool shown in working position in Fig. 1 were made and the results are all that could be desired. Fig. 2 shows the form of the chuck which is threaded to screw on the lathe spindle. Steps are turned in its face to take the different sizes of commutators which, after being trued up on a mandrel and the ends squared, are turned a short distance at each end to fit these steps. The center hole is fitted with a phosphor-bronze bushing to receive and support the nose of the boring bar. The clamp shown disconnected is to hold the commutator securely against the chuck in the manner shown in Fig. 1. The boring bar fits a socket adapted to the tail spindle. The other end, being supported by the bushing, makes it a very rigid tool. The cutter is made from carbon steel ⅜ inch square, and protrudes from the bar at an angle with its axis. The secret of its successful operation lies in the shape of this cutter. It should be ground to the correct length while set in its place with the bar on centers in the grinder. The clearance on this part should be very slight—merely stoned off. The cutting edge may be ground by hand to the angle required for the dovetail projection in the bore of the commutator, and should have very little clearance and a large amount of top rake. In other words, the cutter should be as keen as possible without being too weak. A roughing and a finishing bar may be used, but all small sizes can be easily bored with one cut.

With a plain cutter inserted ahead of the

angular cutter and the bar made longer, the straight surface in the middle of the commutator could be easily bored, but so far we have done this with a separate bar fitting the same socket.

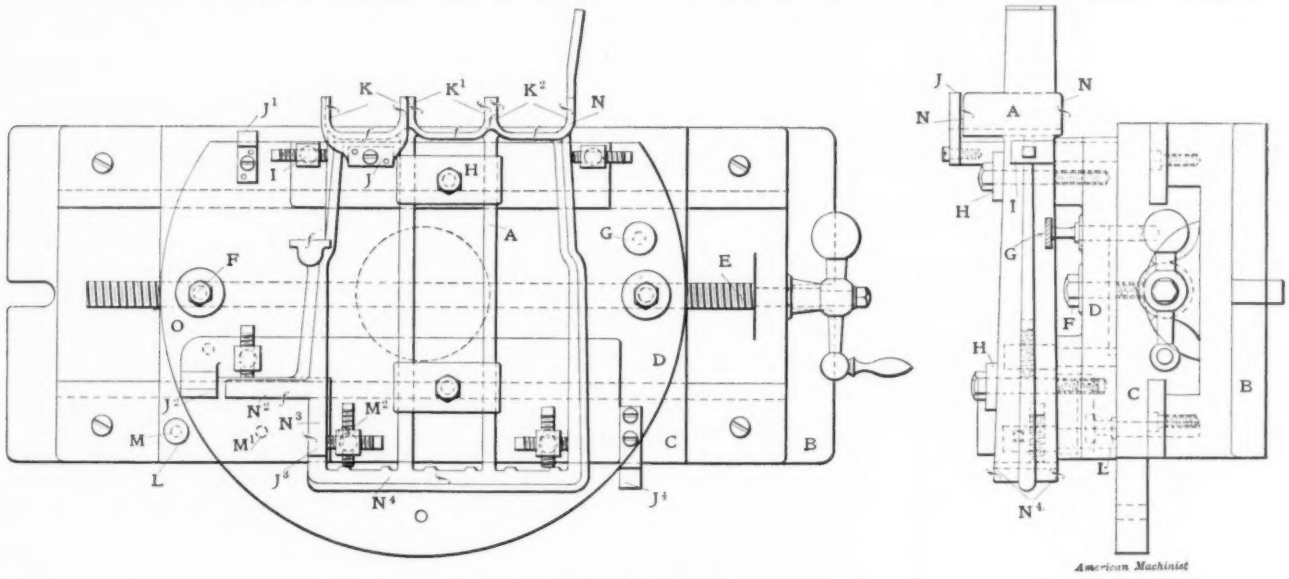
When one end is finished the commutator is turned end for end and the other bored. A liberal supply of oil should be used on the cutter. H. B. McCABE.

A Milling Fixture.

Editor American Machinist:

The drawing shows a plan and end elevation of a milling fixture designed to handle conveniently the casting *A* which is shown in position on the fixture and which is machined at surfaces designated by finish (*f*) marks.

Previous to making this fixture it was considered quite a difficult job to machine these castings satisfactorily in all respects, while now we get finished castings that are duplicates of each other and at a cost 80 per cent. less than formerly.



MILLING FIXTURE.

In handling this casting without a fixture it required several different settings to machine all the finished surfaces, which was necessarily expensive. With this fixture, however, the casting is set but once for all the milling operations, and by the use of positive setting gages the cutter can be accurately adjusted for each operation, thereby doing away with the use of scales, calipers, square, etc.

The fixture consists of a base *B*, a slide *C*, and a top plate *D*. The tongue at the bottom locates the fixture on the milling machine table to which also it is securely clamped. Slide *C* is fitted to base *B* and secured by gibs, and may be moved endwise thereon by means of screw *E*. Plate *D* is recessed at the bottom to fit a hub or projection on *C*, thus permitting it to swivel; it is secured to *C* by the cap-screws *F* and located positively by the removable pin *G*. The two straps *H* and the series of adjustable stops *I* hold the casting in proper position for milling. *J*, J^1, J^2, J^3, J^4 are gages by which the cutter is accurately set for milling the different surfaces. The spacing at *K*, K^1, K^2 is accomplished by the removable pin *L* and the holes *M*, M^1, M^2, which are accurately spaced in base *B*. After setting the end mill by the removable gage *J* with pin *L* inserted in hole M^2, the surface at *K* is milled; pin *L* is then removed and, by means of screw *E*, slide *C* is moved along until the pin can be engaged with hole M^1 when surface K^1 is milled; to mill K^2 repeat the operation by again removing the stop pin and shifting the slide until the pin can be engaged with hole *M*. To mill the surfaces at *N*, set the cutter by the top and bottom of gage J^1. By removing screws *F* and pin *G* the top plate *D* can be turned around and accurately located at 180 degrees by pin *G* engaging with hole *O*. The end mill is then set to gage J^2 to mill the surface N^2; gage J^3 locates for surface N^3, and gage J^4 for surfaces N^4. W. M. SPRYE.

The English Apprentice and the American.

Editor American Machinist:

This letter is not exactly in reply to, but was prompted by, the letter over the appropriate *nom de plume*, "Instigator," at page 1375. I am American by birth, but when the time came for me to choose a profession I happened to be in Scotland. My parents being resident there, and I the youngest, it was decided that I should serve the five years' apprenticeship in Glasgow, Scotland.

I was a "premium" apprentice—that is to say, my father paid £100 to my "masters" (so they were termed in the indenture). I was to receive compensation during the first year at the rate of seven-eighths of a penny an hour, or for a full week of fifty-four hours I received the princely sum of 94 cents. I was nearly nineteen years old at the time and was considered handy with tools. The first twenty months of my time was in the pattern shop. Here were employed about twenty patternmakers, and probably ten apprentices. There was absolutely no distinction made between the premium and the common variety of apprentice, the sole aim of the foreman and the men being to teach the apprentices as much as possible. Several times when I went to the foreman for a job he would say: "I have not got a job for you; but what would you like to make. Have you ever made so and so?" On receiving a reply in the negative he would go to one of the pattern lofts, find a pattern that needed renewing, show me how to lay it off, etc., and start me on the job. On one occasion, when the shop was slack (and he knew I had finished the last job he had given me), he caught me trying to hide a job I was working at, under the bench. He at once asked me what I was hiding. I replied that my father had given me sufficient money to buy a lathe, but that I wanted to make one throughout myself, and that what I was hiding under the bench was the pattern for the bed. As I look back now I can see what a hard-looking lathe bed that was, with its gap near the headstock. He made me haul it out, pointed out its most glaring defects, showed me how to remedy them, and even told the journeyman with whom I worked to help me out if I got into difficulties. I made all the patterns for that lathe, molded all the parts in our foundry, chipped, filed and scraped the bed, heads, saddle, slide rest, etc., at home, and eventually, before I went to sea, sold it for £8. After my twenty months were finished in the pattern shop, I was put in the fitting (erecting) shop. The first job I got was chipping the edges of floor plates for a 24-foot mash tun for a distillery. These plates were about 5 feet by about 6 feet; the edge was in the shape of a flange on one side and was about 3 inches wide. These had to be chipped approximately straight. They could have been put up and planed in gangs in a

tithe of the time I took to chip them, but that would not fill my master's part of the contract, "to teach me the whole business of an engineer and millwright as practised by him," and so I was kept chipping and filing at jobs that cost, not in wages, but in delay ten times what they ought.

In the fitting shop, when there was a lack of work, we apprentices made the fearful and wonderful small tools which, even to this day, some depraved machinists (companions of my youth) point to with pride and say: "I made that square (?) when I was serving my time."

From the fitting shop I went to the finishing shop, where the finer quality of machine work was done, such as fitting brasses, finishing links, rods, straps, etc. While in the finishing shop I was taught how to make reamers, rosebits, counterbores, and so forth. All the drilling was done with flat drills in drill presses with tapered square holes in their spindles. The drill was forged and ground (on a grindstone), the square shank wrapped with emery cloth or paper, was then inserted in the square hole in the spindle; a tap with a hammer, varying in force with the diameter of the drill, drove it home. The drill press was then started, and a piece of chalk was held so that the eccentricity of the drill could be marked on it, then a lateral bang with a hammer would either true it or not, according to the skill of the operator. You may laugh at these methods, but the firm had a world-wide reputation for good work, work that seldom required repairs of any sort and work that never broke down. Occasionally I worked to blueprint, upon which there were no sizes marked. These blueprints would shrink unevenly, and a piece that was apparently parallel would measure up, say, 1 inch in one place and 1¼ inches in another place. On asking Mr. Jack (the managing partner) about such a discrepancy, he would cock his head on one side an say, "Mack it a quatter o' an inch thicker than ye think it ocht to be and mack a note on th' draa-in." This sometimes led to a little trouble, but the engines and machines were always, as the Dutchman said, "Hell for strong."

From the finishing shop I went to the drawing office, where I learned how to make blueprint emulsion, coat the paper, make the blueprints, tracings, mechanical drawing, and finally designing. I have a natural ability to sketch, and in the drawing office I saw the first and only signs of my employer wanting to make money out of my abilities. I was often sent out to take sizes and make sketches as soon as my speed and reliability in that part of the work was proven. During my last year my weekly emolument was $2.60.

It is twenty-two years since I went to serve my time, and in those years I have held all kinds of positions, from sole proprietor of a one-horse machine shop down; but I have always given the apprentices under me as near the same treatment I got as possible. When boss of my own shop, and I had some job out of the ordinary run, I always stopped the apprentices on their various jobs and showed them, step by step, how the work was done. The consequence was that I had the reputation of turning out journeymen that knew their work. Another little hobby of mine was paying either men or boys what they were worth and treating them like human beings. There were some men who, mistaking decent treatment for easiness on my part, took advantage, but when I caught one trying to *do* me, it was out into the cold, cold world for him. I have never had a man leave me without giving me whatever length of notice I desired; and if one of my men was working elsewhere and I wanted him, he was always on tap for me.

DIXIE.

Jig for Planing a Compound Rest Swivel.

Editor American Machinist:

A compound-rest swivel for a lathe is shown at Fig. 1 and a jig for planing them at Fig. 2. To get an idea of the advantage gained in using the jig, it is best to explain the old way. It consisted of first clamping a lot of the castings in a row, using two bolts and clamps, four little parallel blocks, a lot of washers and wooden blocks for each. Altogether, enough stuff to fill a soap box was used in holding ten of them on the planer.

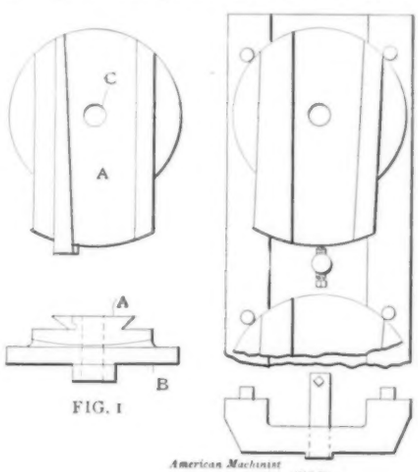


FIG. 1 FIG. 2

SWIVEL AND JIG.

The top surface *A* was first finished, then taken to a lathe and the bottom *B* turned off and the hole *C* bored; it was then returned to the planer and set upon the four little parallel blocks again and bolted down thru the hole *C*. The taper side was lined up with the planer table, and it can be imagined the job it was to keep the edge in line and holes central when drawing up the nut. The gib was next fitted in, being made tight enough so that it would hold while being planed in place. They were next swung around straight, lined up, and the dovetail finally finished.

A cut any way heavy was out of the question at any time, as it was thought safer to take three or four hours longer than to chance the job moving. The jigs were made about 5 feet long for easy handling, and two were used on a 10-foot double-head Gray planer. They were drilled so the stops and pins could be placed in different holes for different size swivels.

The holes were in line for the smaller pins and square crossways, therefore when the swivels were set against them the holes had to center up in line and all that was needed was to line them up with the side of the jig and tighten the set-screw in the stop. It was an easy matter to swing them taper or straight.

When using the jigs the swivels were first rough turned on the bottom and, once on the planer, never left it until all planing was done. This, of course, saved one setting of the job and the hauling back and forth from the lathe, that three or four hours' fear of moving was also saved.

There is a trick in using a stop as shown in the sketch. When the set-screw is drawn up, the stop will spring back some and throw the point of the screw upward and lift the piece with it. To get the job down, just tap on top of the stop with the hammer until the job is solid.

Most fellows don't seem to understand that the more clamps used on a job the more chance there is of springing it, and are stuck when given a job with no apparent place that can be covered with clamps.

CAMERON.

Heavy Lathe Cuts With High-Speed Steel.

Editor American Machinist:

The report at pages 1484 and 1485, by R. G. Griswold, of the results of a tool-steel test made on an 84-inch lathe is more than interesting, for not only is a cut 1⅞ inches deep with ⅜ inch feed taken in high carbon steel remarkable, but also the power required to take this cut at approximately 50 feet a minute must have been considerable.

Of course it is well known that with chips of ordinary proportions the power required to remove a cubic inch of steel per minute varies inversely as the feed (approximately as the square root of the feed has been my experience) and for big feeds it may be comparatively low. But even so, assuming a coefficient of 33, which surely is low for high carbon steel, the power demand would be estimated at $440 \times .33 = 145$ horse-power, which is surely a good deal to be absorbed at one tool.

Possibly the feed was not ⅜ inch for the statement is also made that the thickness of the chip was ⅜ inch. Could not Mr. Griswold clear up this point and also give us some idea of the power that actually was required, either at the tool or gross at the motor?

This would be most valuable data, for it is seldom that a power test is made under such extreme conditions.

E. H. W.

Molding Sheaves.

BY JOSEPH HORNER.

Sheave patterns are made in both wood and metal, jointed and unjointed. The objection to jointed patterns in wood is their flimsiness, even tho built up carefully in segments. Iron patterns, tho jointed, are free from this objection. But another drawback with the joint is that a three-part flask is generally used, with the risk of drop-outs; hence the reason for the method adopted in Figs. 1 and 2, which shows the molding of a common rope sheave, made from a complete iron pattern, jointed, without the use of a middle part flask.

The under face of the pattern is rammed up on a temporary mold, and turned over in the usual way, and it is then in the position shown on the right-hand half of Fig. 1. The sand joint slopes down from the pattern joint to the box and then sweeps around flat in the same horizontal plane *A* as the center of the convex edge of the rim. A thickness of parting sand is strewn over this joint, and a flat ring *B*, about ½ inch thick and 2 or 2½ inches in width, furnished with lugs *C* is laid upon it. Thin flat stakes *D* are driven down into the sand on each side of each separate lug, these being the guides by which the ring is replaced after the mold is made. Over this ring a thin layer of sand is strewn, and nails are bedded horizontally in it, projecting into the groove of the pattern. Additional sand is laid on and partly rammed, and when nearly to the same depth as the pulley groove the top half of the pattern is laid on, as seen at the left-hand side of Fig. 1, and the ramming is finished up to the top joint *E*. Afterwards the cope *F* is put on and rammed. When this is lifted the face *E* of the ring of sand is exposed. The top half of the pattern is now drawn. Grooves are then cut, and hooks are inserted under the lugs *C* of the ring *B*, by which means it is gently lifted away with the sand which it carries, and the bottom half of the pattern is afterward drawn. After cleaning up, the ring of sand is replaced, being guided into place by the thin stakes *D*, the groove which was cut around it is filled with

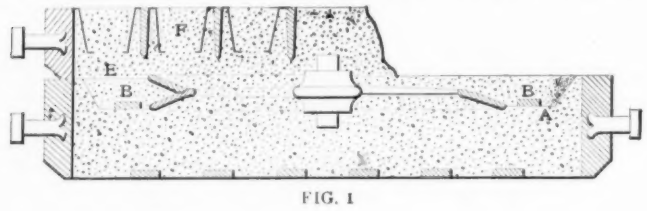


FIG. 1

FIG. 6

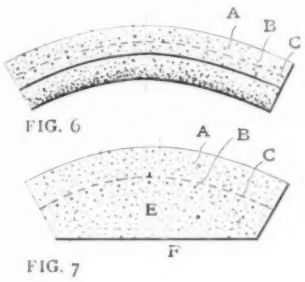


FIG. 7

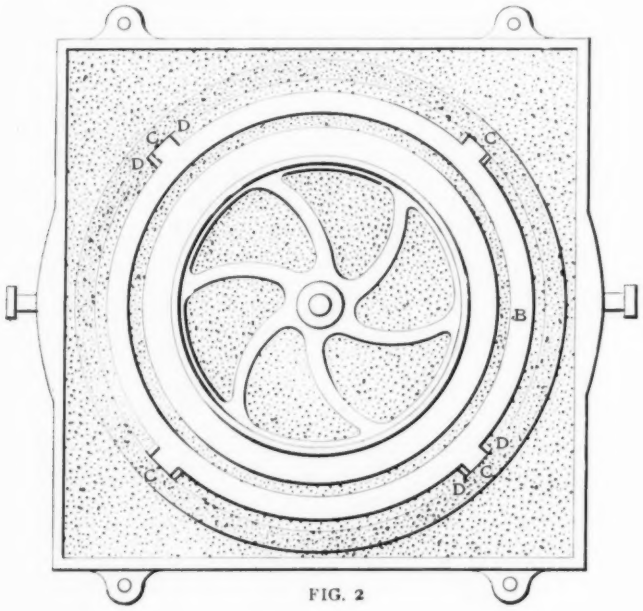


FIG. 2

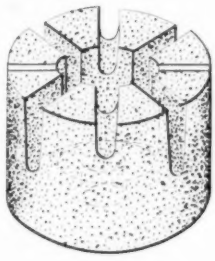


FIG. 8

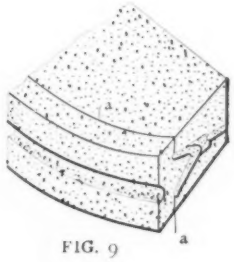


FIG. 9

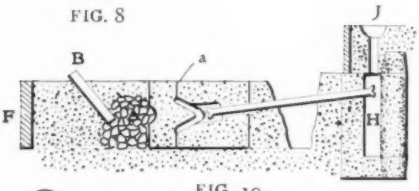


FIG. 10

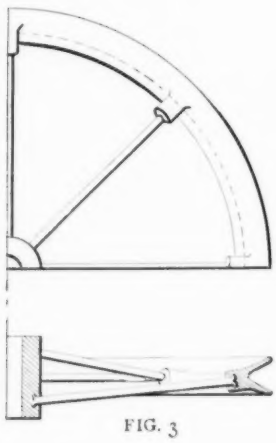


FIG. 3

FIG. 4

FIG. 5

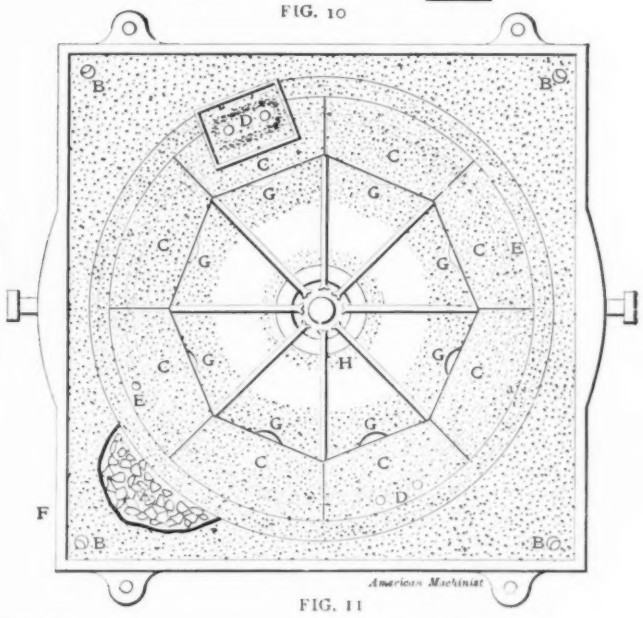


FIG. 11

MOLDING SHEAVES.

sand and the cope is put on finally. The sheave is poured at the boss.

Sheaves with wrought-iron arms are frequently made from complete patterns, but as the molding of the pattern ring would be nearly a repetition of that just shown, I will suppose the pulley, Fig. 3, to be made with cores instead of with a pattern, as is the frequent practise in this class of work, especially when of large diameter.

For this we want two core boxes, one for the outside, the other for the inside of the rim, and a central boss with prints. Fig. 4 is the core box for the groove, and Fig. 5 that for making the back or inside of the rim. Looking at these boxes, and at the sections of the cores made from them, Figs. 6 and 7, we see that the boxes are of the same width and the cores consequently of the same thickness, so that a plain bed and a plain open box without bars are wanted, the cope being also frequently dispensed with, as in the example. The cores likewise fit each other by curved edges, having sufficient bearing faces, and closeness of contact to prevent the metal from running away at the joints. The length of each section of the cores is chosen as most convenient for making and handling, and sufficient altogether to make the complete circle required. The construction of the boxes is sufficiently obvious from the perspective views, so we go on to the making and setting of the cores, arms and boss.

The cores are not made with grids, unless of large size. Fig. 6 shows a core, made from the box Fig. 4, for forming the pulley groove, *A B* being ¼-inch rods rammed in radially and transversely, and *C* two or more long rods rammed beside these, for the purpose of forming a skeleton framework to the sand rammed around and among them all. Large vents are made by ramming up a number of rods radially among those marked *A* in the core, and about equal in number, leaving their ends projecting so that they can be drawn out on the completion of the core, thus leaving a sufficient number of vents of large size.

Fig. 7 shows the other core made in the box, Fig. 5, forming inner portion of the rim, or that facing towards the boss. Here the rods *A, B, C*, as in the last, stiffen the core, but as the mass of sand is greater, ashes are rammed up in the space *E*, communicating by an opening at *F* with the outside. The central boss is made with pocket or drop prints and rammed up in core sand within a pulley pattern rim, for convenience, and the mold of the boss, when finished, has the appearance of Fig. 8.

For the molding and casting of the sheave, a level bed is strickled off, and the exact diameter of the curved abutting joint faces *a* of the cores in Fig. 9 is struck thereon, and these are laid down to the line so struck all around to see if the core lengths are correct to complete the circle. If they do not come quite right, and the diameter can be varied within slight limits, they can be shifted inward or outward, as required. Or, if one set comes right and the other set is not quite correct, a little alteration must be effected by filing, or, if short, by opening each joint to a small amount, thus causing slight fins on the casting.

We suppose the cores are all in place and the arms inserted at their alternate angles and resting at their opposite ends in the drop print recesses of the central boss, which is set in place by measurement and with a spirit level. Now a middle part flask *F*, Figs. 10 and 11, is placed around the mold, a circular stratum of ashes, shown exposed at *A*, Fig. 11, is strewn around the outer cores and lightly rammed down, to bring away the air from the grooves around these cores; compare Figs. 10 and 11. Fig. 10, it should be noted, is taken diagonally thru Fig. 11. Plates of iron are now laid on the tops of the cores all around and weighted, and then the whole of the space between the ashes and the enclosing middle part is filled in with sand and rammed, four vent pins *B* being inserted diagonally to bring off the gases from the ashes, the latter being covered with a stratum of sand.

The vents from the ashes in the inner ring of cores *C*, the joint of which with the outer cores is at *a*, are brought directly upward by ramming vent pins, forming vents *G*, Fig. 11, against the faces of those cores, leading up from the vent holes, sufficient sand being rammed within the cores to prevent any risk of their shifting. The runners *D D* are made thru the sides of two of the cores, Fig. 11, and are poured from basins rammed on the cores direct. The risers *E* are made in a similar fashion.

The ring is poured with hot metal. The boss *H* is not poured at the same time nor for hours afterward, because its contraction is very slight in comparison with that of the rim, and if it were opposed to that of the latter the ring would become fractured, or at the least would be put into a condition of great tension or the arms would bend. The rim must have cooled down to a black heat, so that the hand can almost bear it, before the boss is poured. Then each arm is stopped over with sand in the place where it rests in the core enclosing the central boss, and the metal is run thru the top, a small runner box *J* being rammed over the boss in the usual manner. If the boss is large, it is then desirable to uncover it, and allow it to cool as rapidly as possible before it has time to transmit its own heat thru the arms to the rim, and so expand it overmuch. If very massive, it may be necessary to cool it off more rapidly with water or at least to keep the arms cool.

Bath, England.

The dead weight of live people in dense crowds may go up to above 150 pounds per square foot of floor area or will equal 29 inches of water.

American Export Trade and its Deficiencies.

BY RENE WOHLFARTH.

In striking contrast with the proud figures on record for the export of our manufactured goods, are the primitive export methods pursued by our manufacturers. There is, indeed, no telling what wonderful proportions these figures might have attained in the past, and may yet attain in the future, would our manufacturers more generally show the necessary initiative, exhibit a proper understanding of the situation and familiarize themselves with the necessities of the occasion.

The success attained in the export of our manufactured goods may be traced directly to the unsurpassed excellence of our products, appreciated all the world over, and, strange to say, the credit for this success is due more to the sagacity of the foreign merchant and dealer than to that of our manufacturers. This state of affairs is partly due to a certain apathy of our manufacturers and an improper conception of the economic importance of export trade, both from an individual and a national point of view; partly also to a lamentable ignorance of matters mercantile, especially in foreign lands, and, lastly, to inadequate facilities to face the problems confronting them.

In regard to the economic importance of cultivating an export trade, every manufacturer is, from a business point of view, placed in much the same position as a fire or life insurance company: if the latter has an evident interest in distributing its risks in as many and far distant lands as possible, in order to guard against the fatal effects of a devastating fire in one large city or an epidemic in one portion of the globe, the manufacturer has as great an interest in securing as many markets as he can possibly get hold of, in order to ward off the evil consequences of a stagnation in his domestic trade, which he is bound to face sooner or later with mathematical certainty. Furthermore, the increase of his output will infallibly cheapen his cost of production, and he cannot afford to make light of this opportunity. Lastly, in times of complete domestic stagnation, the export trade built up in times of prosperity will enable many a manufacturer to keep his shop running, while his neighbor without this export trade has to close up for want of orders. The far-reaching importance which this factor alone has for the national prosperity, is perhaps a matter which the individual manufacturer cannot be fairly expected to pay much attention to; still, a proper appreciation of the benefits which an export trade carries in its wake, cannot fail to assist in stimulating the individual efforts of the manufacturer, and let him at least be reminded that the influx of foreign gold enriches him not only directly but again indirectly thru its circulating power and the enhanced purchasing ability of the domestic consumers. Who, after all, but the manufacturer

reaps the main benefit from easy money conditions thus created?

So much for the importance of cultivating an export trade. But which is the golden road that leads to it? There is only one proper road, and I shall clearly define it. It may, however, be instructive to examine first the present methods employed by the vast majority of our manufacturers in their export efforts, and to demonstrate the faultiness—in some cases the hopelessness—of their proceedings. This majority probably comprises upwards of 90 per cent. of our manufacturers. According to the respective methods employed by them, they may be divided into three different groups, each of which presents distinctive features.

First in line stands the manufacturer who naively attempts to do his export business on what may fittingly be termed the "mail-order" plan. His methods are briefly as follows: He advertises in one or two trade papers which have a circulation abroad, soliciting inquiries for his catalogs. An occasional request for his catalogs is his reward, and he promptly responds by sending a copy of his catalog (generally printed in English!) to the foreign applicant, informing him in a more or less lengthy communication that he will be very pleased to sell him his products and that his terms are "cash with order." Here and there, say out of twenty such applications, he strikes a *bona-fide* buyer—only to find out soon that his buyer is not a dealer but simply ordered the goods for his own personal use. This manufacturer flatters himself that he is doing an "export business," while in reality it is nothing short of a parody, and the green grocer's principles on which he seeks to do business abroad would bring a broad smile on the face of the English or German manufacturer.

Next in line comes the manufacturer who clings pitifully to the American general commission merchant. He declares, in contradistinction to the manufacturer of the "mail-order" type, that he does not care to have one small buyer here and another there, even tho they may send him "cash with order." He, too, wants "cash," but he opines that nothing can beat the convenience of receiving an order thru a general commission merchant, for all he is required to do is to ship the goods to New York, to present his invoice, and to get the cash for it. Metaphorically speaking, the general commission merchant's office is his opium den, whither he joyously drifts to get his senses flustered. He never becomes aware how dearly he has to pay for the "convenience" gracefully extended to him. It is quite evident that no general commission merchant would make it his business to push any one brand in particular. He has no occasion to do so; for he is on good terms with all manufacturers and matters come his way in a more tempting shape. If he gets an order for a certain article he will suit his own convenience and look up the cheapest source of supply or the source leaving the largest margin of profit for him. Even if a special brand should be called for and he should find another source of supply more profitable, he will often not hesitate to tell his customer that the particular style he wanted is no longer made by the manufacturer in question, and that he is supplying him with what comes nearest to the style wanted—secured, of course, from a different source. He is not in business for love, and you cannot blame him. In addition to the damage thus inflicted upon the manufacturer, the latter is, perhaps unconsciously, lulled into relaxing all further export efforts, as he has been led to think that he is actually doing an "export business," and that this is the best he can hope for. By far the greatest damage is, however, inflicted upon this manufacturer thru the fact that, by the time his goods reach the consumer, they have had to stand so many liberal commissions that the last dealer has had to be pretty clever to dispose of the goods, and it may be taken for granted that both the German and the English article can in that market sell at a much lower figure, or else leave a considerably larger profit in the dealer's hands. What this means, from a business point of view, needs no further illustration.

Next in line, but representing the most advanced group of the three, comes the manufacturer who has reached the conclusion that he will never be able to do his export business properly unless he transplants the base of his export operations to New York; and, according to the degree of his progressiveness, he resorts to either of the following means:

He places his export interests completely and unreservedly in the hands of a New York concern which is no longer a general commission house, but a firm which (with occasional exceptions) handles only half a dozen lines, acting as special export agents for as many different manufacturers. In this case the manufacturer contrives to relieve himself of all export cares: he gets cash for his goods, does not care where his goods go to, and any volume of business thus secured is a welcome addition to his domestic trade, a windfall, as it were, involving no trouble and no risk. The fact demonstrated that his goods are still marketable after his export agent has added a handsome commission to the original price seems to be no food for his thoughts. He is perfectly satisfied to rest on his laurels, even tho his present indirect buyers and even whole markets would be only too anxious to accept the better terms which he can quote direct. If questioned on the subject, his justification is that he prefers spot cash (or cash within 30 days) and to be relieved of all further "bother." A most interesting factor, however, which he seems to ignore entirely is that his New York agent is not by any means a capitalist and that if he (the manufacturer) gets ready cash for his goods his agent does not pay for them out of his own pocket or advance the money to him from his own bank account. In most intances the agent is a man of quite limited means whose business capital does not begin to compare with that of the manufacturer—still he can pay cash for the goods. The explanation is very simple: his (the agent's) banker is ever ready to advance the money against the shipping documents. But what this banker is willing to do for the small agent he would most cheerfully do for the rich manufacturer—would the latter but approach him direct.

The more progressive manufacturer of the last-named group comes to New York to open there an "export office" of his own, placing a salaried man in charge, whose mission it is to work up an export trade; frequently the manager of this export office draws also a commission on the export business secured. The advantages thus gained are, however, purely fictitious, inasmuch as he could obtain the identical results direct from his home office by starting a little export department. Not even in attending to the shipments from New York can this export office be of much practical use, as all formalities connected therewith could to as good advantage be looked after by any responsible forwarding agent at port of shipment or by the International Freight Bureau of the National Association of Manufacturers, which attends to these shipments as disinterestedly as efficienctly and at actual cost. It will be found that the gentleman who is in charge of such New York export office is, moreover, in an overwhelming majority of cases, a complete novice in export matters. His efforts are mostly of a tentative nature, he is groping about in the dark, for he expected to get valuable information in New York which is not forthcoming, and eventually he plunges headlong into the clutches of the general commission merchant. Even his laudable efforts to secure buyers abroad by means of circulars (which might as conveniently have been sent out direct from his home office) are wrecked thru the unwillingness of the manufacturer to depart from his customary domestic business methods; and thus—perhaps unaccountably to him—the best efforts are nipped in the bud by unreasonable terms of payment and by a want of understanding how to work a foreign market on its old, time-honored basis.

All the different methods resorted to by the generality of our manufacturers are unsatisfactory for one reason or another: they are only ingenious but poor substitutes for the true requirements. The main evil, which they have all in common, consists in the *impropriety of the basis* selected for the export operations. Only a small tenth of our manufacturers has so far distinguished itself by breaking loose from the general onward march in the dark. This tenth includes the score of pioneers who have made themselves thoroughly "at home" in the various markets of the world

and their accomplishments ought to command the admiration of all the others and incite them to at least partial emulation. But the facilities at present at the disposal of the remaining nine-tenths are somewhat limited and inadequate, and besides a very large contingent of our manufacturers has not yet learned the intrinsic difference which exists between the domestic business and an export trade: for it would be puerile to imagine that all the difference should consist merely in the local distance from the buyer.

To do business *successfully* in any one market, it is necessary to know this market well. This is a fundamental principle, as essential for the home market as for *any* foreign market. You must, in the first place, know what the requirements of that market are, what competition you have to face, and what the prices and terms of your competitors are. You require, furthermore, a number of indications which only an intelligent and reliable native merchant can give you, who watches conditions closely on the spot, who is in daily touch with the buyers or consumers, and will report to you immediately all changes arising. Unless you choose to settle in that market under your own firm name—which you cannot afford to do at the start, but will surely do in course of time, should the volume of business warrant it—you cannot do without the services of that *local* merchant or representative. It follows from this naked truth that the *only* proper way for a manufacturer who wishes to take up a certain market, is to appoint a reliable representative residing in that market. It follows, furthermore, that as many markets as he wishes to work, as many different, qualified representatives he must appoint. He need not necessarily pay them a salary, as a moderate commission will be sufficient compensation. It would, however, not be good policy to appoint as your agent or representative any firm which may happen to address its offers to you and regarding which you may receive a favorable report. The only right plan to appoint a suitable representative, is to make your own selection among the most desirable men or firms available, as your business may call for special qualifications, and you may be sorry some day that you did not make a more advantageous selection. You need the best man, not the second best, and you must look for him.

Many a manufacturer (tho belonging to that tenth which is least in need of advice) commits the mistake of conferring upon one individual or firm his "General agency for Europe." But if all these manufacturers would change their tactics and hunt for desirable *local* agents in each different country (selecting such firms as have either traveling salesmen of their own or branch houses or sub-agents in the various minor markets of the same country), the increase in their export figures would quickly become a pleasant surprise to them.

Our manufactured products have at present to pass thru too many different hands, and by the time they reach the small dealer or consumer their price has assumed impossible proportions. Therefore it must be the aim of every manufacturer to eliminate all unnecessary intermediaries and commissions and to reach the consumer thru as short a channel as possible. The appointment of suitable, intelligent and active, *local* representatives presents the solution of the whole problem; it need only be supplemented by proper banking arrangements, which are within the reach of every manufacturer.

Safe Speeds for Gray-Iron Flywheels.

The accompanying very useful table of flywheel speeds is by W. H. Boehm, superintendent of the flywheel department of the Fidelity & Casualty Company. The table is figured for a margin of safety on speed of approximately three, which is equivalent to a margin on stress developed, or factor of safety in the usual sense, of nine.

Type of Wheels and maximum obtainable efficiency of rim-joint

Diam. in Ft.	No joint 1.00 R.P.M.	Flange joint .25 R.P.M.	Pad joint .50 R.P.M.	Link joint .60 R.P.M.
1.	1910	955	1350	1480
2.	955	478	675	740
3.	637	318	450	493
4.	478	239	338	370
5.	382	191	270	296
6.	318	159	225	247
7.	273	136	193	212
8.	239	119	169	185
9.	212	106	150	164
10.	191	96	135	148
11.	174	87	123	135
12.	159	80	113	124
13.	147	73	104	114
14.	136	68	96	106
15.	128	64	90	99
16.	120	60	84	92
17.	112	56	79	87
18.	106	53	75	82
19.	100	50	71	78
20.	95	48	68	74
21.	91	46	65	70
22.	87	44	62	67
23.	84	42	59	64
24.	80	40	56	62
25.	76	38	54	59
26.	74	37	52	57
27.	71	35	50	55
28.	68	34	48	53
29.	66	33	47	51
30.	64	32	45	49

American Machinist

SAFE SPEEDS FOR GRAY-IRON FLYWHEELS.

Electric Smelting in Europe.

The Department of the Interior of the Canadian Government has just issued an interesting report of the investigation made in Europe by the Haanel commission into the different electrothermic processes for smelting iron ore and making steel of various grades. Dr. Haanel, the head of the commission, is Superintendent of Mines for Canada and his associates were men of competence and standing. Electric smelting plants were visited at Gysinge and Kortfors, Sweden; La Prag, France; Turin, Italy, and Livet, France. The conclusions arrived at by the metallurgist of the commission, Mr. Harbord, are as follows:

1. Steel equal in all respects to the best Sheffield crucible steel can be produced, either by the Kjellin, Heroult or Keller processes at a cost considerably less than the cost of producing a high-class crucible steel.

2. At present structural steel, to compete with Siemens or Bessemer steel, cannot be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes.

3. Speaking generally, the reactions in the electric smelting furnaces, as regards the reduction and combination of iron with silicon, sulfur, phosphorus and manganese, are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature, by varying the electric current, any grade of iron, gray or white, can be obtained and the change from one grade to another is effected more rapidly than in a blast furnace.

4. Gray pig iron, suitable in all respects for acid steel manufacture, either by Bessemer or Siemens processes, can be produced in the electric furnace.

5. Gray pig iron, suitable for foundry purposes, can be readily produced.

6. Pig iron, low in silicon and sulfur, suitable either for the basic Bessemer or the basic Siemens process, can be produced, provided that the ore mixture contains oxide of manganese and that a basic slag is maintained by suitable additions of lime.

7. It has not been experimentally demonstrated, but from general considerations there is every reason to believe that pig iron low in silicon and sulfur can be produced, even in the absence of manganese oxide in the iron mixture, provided a fluid and basic slag be maintained.

8. Pig iron can be produced on a commercial scale to compete with the blast furnace only when electric energy is very cheap and fuel very dear. On the basis taken in this report, with electrical energy at $10 per electrical horse-power year and coke at $7 per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace.

9. Under ordinary conditions where blast furnaces are an established industry, electric smelting cannot compete, but in special cases where ample water power is available and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

A friend sends us a clipping from a daily paper referring to the new four-cylinder balanced Baldwin compound locomotive, which we are informed not only has four cylinders, but "by working on the crank motion steam is generated all around and continuous power is thus kept up, with a saving of 25 per cent. in fuel"; all of which it will be perceived is of very great interest, particularly the statement that "steam is generated all around."

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Contents.

	PAGE
Things that are Usually Wrong—II.	1525
Design of a 4,000-Ton Hydraulic Press—I.	1526
Milling Machine with Slides and Guides of Equal Length.	1530
The Present and the Future of Engineering on the Pacific Coast—Engineering Experience.	1530
The Reversal of a Planer and the Grinding of a Drill.	1533
Casting Iron or Steel in Metal Molds.	1533
Conservatism in Engineering and in Education.	1534
The Mechanical Engineer of the Pacific Coast.	1535
Letters from Practical Men.	1536-1545
Molding Sheaves.	1546
American Export Trade and Its Deficiencies.	1547
Safe Speeds for Gray-Iron Flywheels.	1549
Electric Smelting in Europe.	1549
Public Exhibition of an Electrical Locomotive for the New Service of the N. Y. C. & H. R. R. R.	1550
Foreign Trade.	1550
The Most Impudent of the Cleveland Oil Swindlers.	1551
Machine Tool Equipment of a Battleship.	1551
Some New Things.	1551
The Tunnel Under the Hudson River.	1554
A High-Speed Steel Failure.	1554
Technical Publications.	1554
Personal.	1554
Obituary.	1555

Public Exhibition of an Electrical Locomotive for the New Service of the N.Y. C. & H. R.R.R.

The official exhibition and trial of the powerful high-speed electric locomotive designed and built for the New York Central & Hudson River Railroad by the General Electric Company and American Locomotive Works took place at Schenectady, N. Y., on Saturday, November 12, for the Electric Traction Commission of the railroad company and their guests, chiefly representatives of the press.

The New York Central & Hudson River Railroad Company is now electrically equipping its New York terminal for a distance of 34 miles on the main line from the Grand Central Station to Croton, and for 24 miles on the Harlem Division to White Plains. It is the intention to handle all the traffic within this district or zone electrically and the locomotive just given trial is one of thirty to fifty which will be used in the haulage of the thru passenger trains, the heaviest of which reach 875 tons in weight and are to be hauled at maximum speed of 60 to 65 miles per hour.

By the use of the Sprague-General-Electric multiple unit system of control, two or more locomotives can be coupled together and operated from the leading cab as a single unit. The motive power may therefore be easily adapted to the weight of the train with no complication in operation and with uniform make-up of train crew. A single electric locomotive will be able to maintain the schedule with a 450-ton train, two locomotives being coupled together for heavier trains.

The locomotive developed remarkably easy riding qualities at high speeds and during acceleration, responding with ease and power to the will of the operator. The exhibition was in every respect successful. There was a feeling among the spectators that they were witnessing a historic event comparable, so far as comparison is possible, with the Rainhill trial of the "Rocket." The comparative absence of noise was especially commented upon. As the train passed the observers there was the roar inseparable from steel wheels rolling upon steel tracks, but as the train approached the noise was almost imperceptible, while, as the empty locomotive passed up and down, one would scarcely have known it had his back been turned.

The section of track which had been prepared for the trial was 4 miles long. Repeated runs were made over it, the spectators being taken into the roomy cab in squads in order to witness the operation of the engine from that vantage point. The speeds made were not remarkably high, the highest reading of the speed indicator noticed by the writer being about 40 miles per hour, but this, no doubt, was due to the comparatively short track. The acceleration was remarkably high and at the same time entirely free from any unpleasant sensation on the part of the passengers. One of the minor features of the locomotive is the fact that it is in the fullest sense a double ender. Its two ends are perfectly symmetrical, even to the operating levers which are duplicated for running in both directions, a fact which will eliminate all necessity for reversal by a turntable.

Foreign Trade.

Elsewhere in this issue we print an article dealing with the above-named subject, from the pen of a man who has had much to do with American export trade in a great many different lines of manufactured goods, and who therefore is entitled to have his views carefully considered. At the same time it is of course not to be understood that his strictures apply to all American manufacturers, or nearly all of them. There can be no doubt, for instance, that very many American tool builders have studied foreign business very carefully and very thoroughly. They have gone to Europe not merely over to "look around a little" and to appoint a more or less passive agent here and there, but have gone abroad repeatedly, have informed themselves minutely regarding conditions in foreign shops, and in foreign markets and know far more about the best way to carry on their businesses there than anyone can tell them. Nevertheless, the attitude and condition described by Mr. Wohlfarth is that of many manufacturers who are either more or less indifferent to foreign trade, or have given it little personal attention and think they are doing all the business abroad they ought to expect simply because they receive an occasional order.

A curious feature of what may be called the international discussion of foreign trade now going on and which is participated in by the consular agents of all the great commercial and manufacturing nations is that the writers of each country declare that the commercial methods of all the other countries are far superior to those of their own. The exporting manufacturers of each nation are advised to study and apply the superior methods followed by the manufacturers of some other or all other countries. Of course there can be no doubt of the entire sincerity of all these various writers, and probably the apparent conviction of each that the manufacturers of his own country are behind those of other countries in their methods of handling foreign trade is due to the fact that no one country is pre-eminent in all lines—that each of them is best in certain lines that have been especially developed, and the consular agents and other writers naturally write of the things that seem to them to be especially commendable and worthy of emulation. However this may be, it is certain that no one who desires foreign trade or who may now, or later, be in need of it can afford to ignore the lessons taught by the experience of others.

The article referred to carries the impression that its writer thinks that American manufacturers are not as well up in

matters pertaining to foreign trade as are the manufacturers of Europe. Generally speaking, we believe this is true, and there are many reasons why it might be expected to be true. This vast and rapidly developing country, extending over an area of greatly diversified capabilities and requirements and within which absolutely untrammeled and free trade is guaranteed by our constitution, has given our manufacturers an unprecedented opportunity for the development of gigantic industries. They have until recently not felt the need of seeking foreign markets, but now the process called settlement, but which is in reality largely monopolization, has proceeded to that point where foreign markets become important and the art and science of carrying on business abroad must be carefully studied, for the same reasons that any other branch of business must be carefully studied. By the "logic of events" our manufacturers will eventually be convinced of the importance of such careful study; in the meantime those who soonest recognize the importance of it will be the better prepared for the inevitable periods when the demand for their products at home shall have fallen off and when, as in the later nineties, foreign markets will be absolutely necessary to keep the wheels turning.

The Most Impudent of the Cleveland Oil Swindlers.

We have received from a tool manufacturing concern in Cincinnati a blank form, gotten up in the semblance of a typewritten letter and sent out by what is called The Reliance Oil & Grease Company, this pretended letter being stated to have been dictated by J. M. Backert, manager, whose signature is also printed. The blank form states in effect that the company named has just received unfavorable report of the financial standing of a party in Cuba who had ordered oils; that these oils are in Cincinnati and are offered at a sacrifice rather than be reshipped to Cleveland. Backert is the man who some time ago pawed the air and threatened to bring suit against us because we said his letters were humbugs and that he had no lots of oil scattered around in various parts of the country, which he was obliged to offer at a sacrifice in order to avoid the expense of shipment home. At that time we invited him to bring his suit, and we now again invite him to bring it, and we repeat that the quotations of prices below the pretended value of the oils (for the alleged reason that he has found that the parties to whom the oils were consigned have no financial standing) are misrepresentations and humbugs, and we are surprised that the city of Cleveland and the Post Office authorities continue to allow this swindling business to be carried on.

Mr. Norton's letter, published at page 1237, has resulted in our being inundated by a flood of communications from our friends in the technical schools, all showing that drawing is well taught in them and that the students draw things that are entirely practical. We of course cannot publish all these communications, but if one had no other knowledge bearing upon the case it would be quite clear from them that it would be erroneous to conclude from Mr. Norton's communication that school-made drawings are necessarily made without any reference to practical considerations or to modern ideas of machine design. Of course Mr. Norton himself had no such idea, and probably his only object was to show how far from practical shop methods and ideas some schools may go.

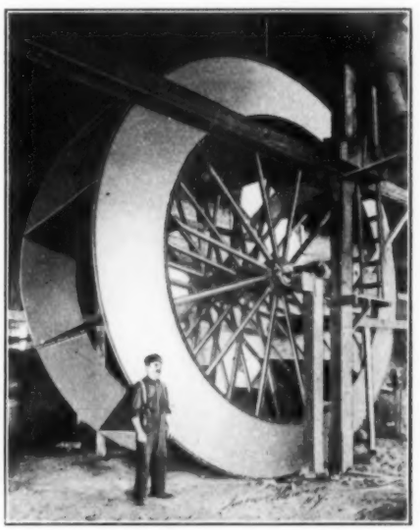
Machine Tool Equipment of a Battleship.

The specifications for the equipment of a 16,000-ton United States battleship call for the following list of machine tools, which are of course to be electrically driven: One screw-cutting back-geared extension gap lathe, to swing 28 inches over the upper ways and 48 inches over the lower ways, and to take between centers 10 feet when extended. One 14-inch screw-cutting back-geared lathe, to take not less than 4 feet between centers. One column shaping machine of about 15 inches stroke and not less than 15 inches traverse. One upright drill press, to drill up to 1½ inches in steel, 14 inches from edge of work, with at least 14 inches traverse of spindle. One 16-inch sensitive drill. One universal milling machine, with at least 18-inch table feed, 4½-inch traverse and 13-inch vertical feed. One combined hand punch and shears, with 6-inch shear blades, to cut ¾-inch round iron, shear ⅜-inch steel plate and punch ⅜-inch holes in ⅜-inch mild steel plates 4 inches from edge. One emery grinder on column, with two carborundum wheels 12 inches in diameter and 2-inch face. One 4x30-inch grindstone, with iron trough, on legs. Six bench vises. One blacksmith forge. It is also specified that all necessary and usual spare parts, tools and accessories for the machines mentioned shall be included in the contract.

Some New Things.

A LARGE FAN.

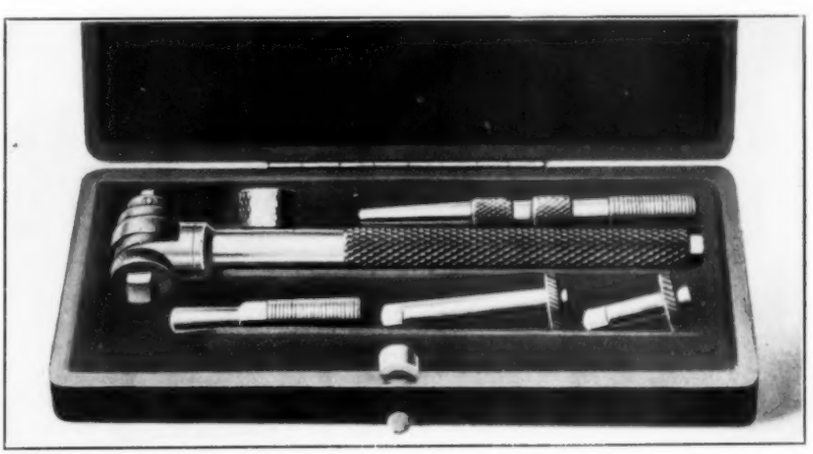
The illustration shows a large fan, said to be the largest in the world. It was built by the Garden City Fan Company, Chicago, in its Niles works for a mechanical draft plant of 5,000 horse-power. The wheel measures 20 feet in diameter by 9 feet wide, the shaft is 9 inches in diameter, and the total weight 7½ tons. The fan (when completed) was encased in a three-quarter housing of steel 36 feet high by 26 feet long.



A LARGE FAN.

INSIDE MICROMETER.

This micrometer measures from .995 to 4 inches, in thousandths, and consists of a head bored crosswise to receive a split and internally threaded bushing, which is clamped by a small eyebolt threaded to fit the end of the nurled handle. The bushing thread is 40 per inch, and one end is provided with twenty-five graduations, so that with one measuring point screwed in tight, the other may be turned by a small nurled spanner to give the desired setting. The measuring points are of such length that with the removable

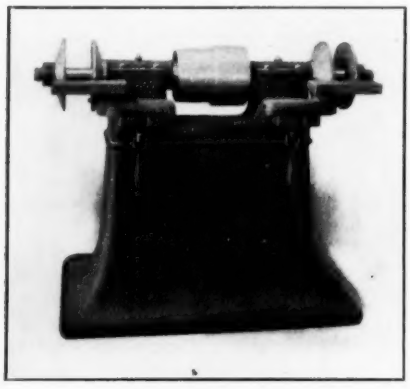


INSIDE MICROMETER.

one screwed up against the one that is fixed, an even inch setting results; the adjustable point is then unscrewed to give intermediate settings by thousandths. Provision is made in the instrument for adjusting for wear on the points. Our contributor, E. J. Towndrow, 7 Victoria Crescent, Globe Road, Chelmsford, Essex, England, is the maker.

A GRINDING MACHINE.

The illustration shows a new grinding machine manufactured by J. G. Blount Co., Everett, Mass. This machine will take wheels 24x4x2 inches. The distance between wheels is 35 inches. The bearings

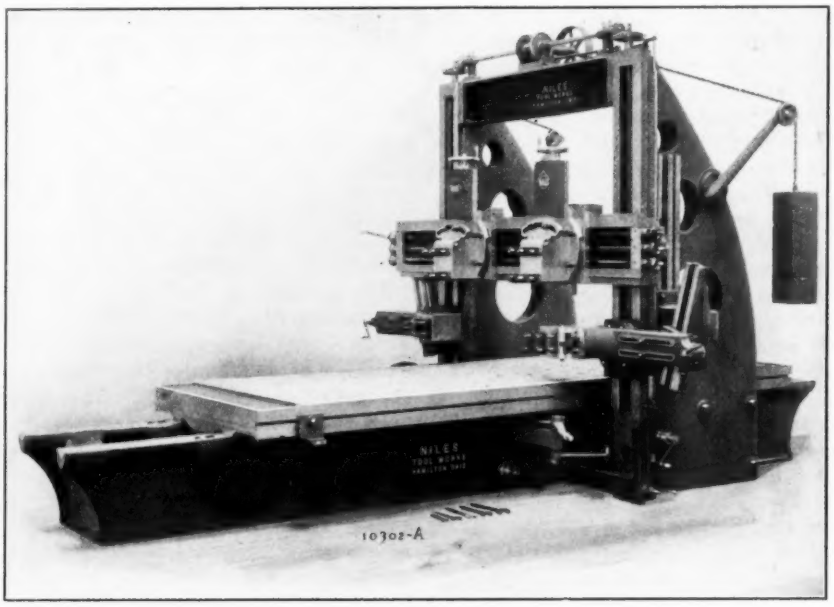


A GRINDING MACHINE.

are 2⅛ inches diameter by 10 inches long. The nuts for clamping the rests have levers attached to them, so that no wrench is necessary.

WIDENED PLANER WITH TAPER ATTACHMENTS.

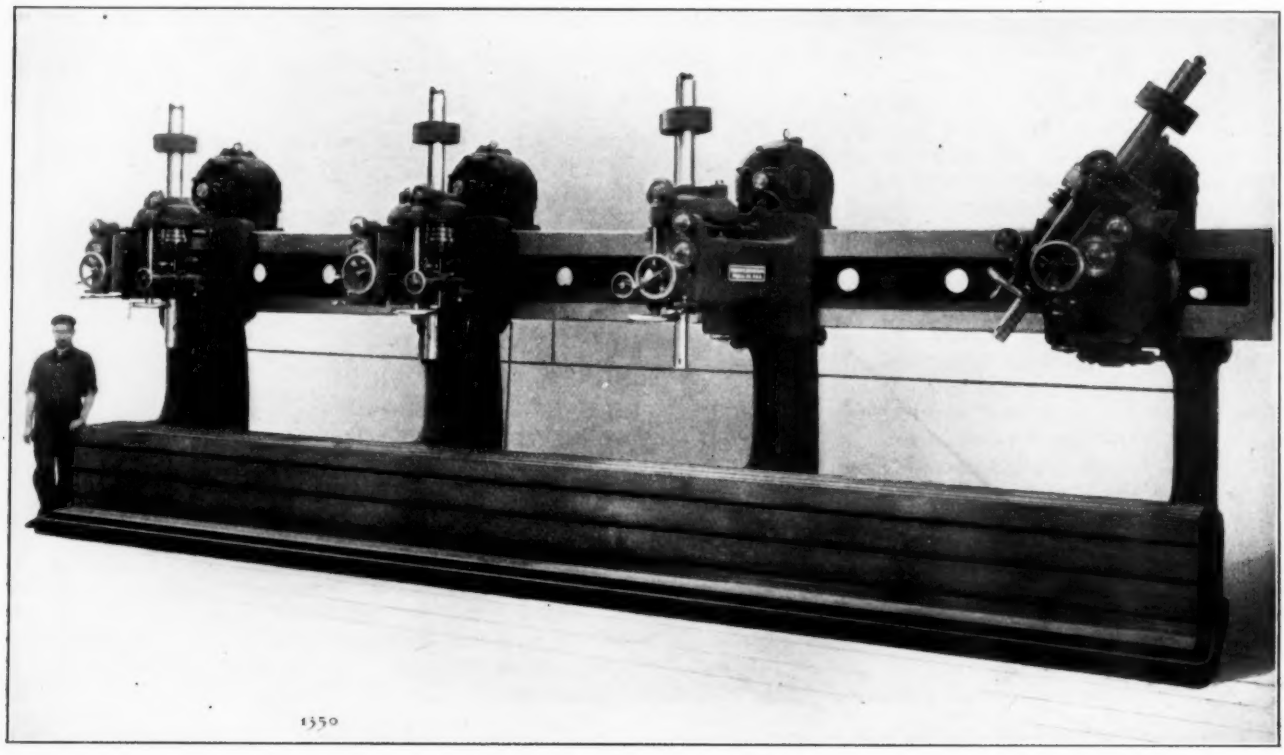
The half-tone shows a 14-foot by 60-inch planer widened and increased in hight to plane 72 by 72 inches and equipped with taper attachments to plane 15-degree angles with the side heads. The machine was built at the Niles works of the Niles-Bement-Pond Company and designed especially for planing gas engine beds. The taper attachments give the side heads a cross movement of 18 inches and allow the heads to plane 24 inches at one setting. The construction and method of attaching to the heads will be understood without explanation.



WIDENED PLANER WITH TAPER ATTACHMENTS.

FOUR-SPINDLE LOCOMOTIVE FRAME DRILL.

As the name implies, this machine is for drilling locomotive frames and has four spindles, each of which is driven by an independent variable-speed motor of 5 horse-power and having a 2 to 1 speed variation. The heads have adjustment along the rail and the saddles also have in-and-out movement on the arms, so that when the work is clamped holes may be drilled at any required points. The head to the extreme right has, as will be noticed, an additional swiveling movement. The saddle on this swiveling arm has an in-and-out adjustment of 16 inches, the corresponding movement of the plain saddle being 20 inches. The spindles have a traverse of 20 inches. There are six posi-

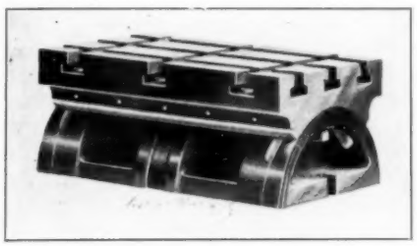


FOUR-SPINDLE LOCOMOTIVE FRAME DRILL.

tive gear feeds, and a range of spindle speeds from 15 to 250 turns per minute. The table is 26 feet long and the maximum distance between outside spindles is 24 feet. This drill was built at the Bement-Miles shops at Philadelphia for the Canadian Pacific Railway.

SWIVEL BLOCK.

The illustration shows a swivel block for use in conjunction with lathe, drill, milling



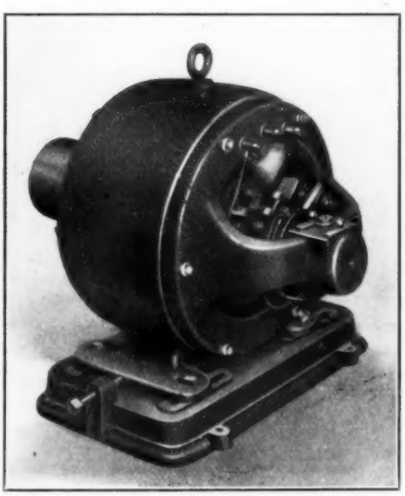
SWIVEL BLOCK.

machine or other tools. The body and table are of gray iron, fitted together on the cylindrical swivel as shown. The ends are graduated, and the table may be swung over to any angle within a limit of 45 degrees and secured in position by means of bolts and nuts at either end. It is obvious that on milling work many special angles (within the limits of this block) may be obtained with regular cutters. It is manufactured by T. Patchett, machinist, Union street, Stoneham, Mass.

A NEW LINE OF SMALL ELECTRIC MOTORS.

The accompanying illustration shows a new line of electric motors, which is made in sizes from ¼ to 7½ horse-power by the Fidelity Electric Company, of Lancaster, Pa.

One of the features of the motors is that



FIDELITY ELECTRIC COMPANY'S MOTOR.

they are made as multi-polar machines down to the smallest size, thus reducing the speed. The frames are of steel, cast in one piece. The field coils are spool wound and before being taped are baked and treated with moisture-proof insulating compound. The armatures are coil wound, and the cores are ventilated by air ducts constructed in the core. The armature, when completed, is treated with the same compound as the field coils. The brush-holders are of the modified reaction type, being provided with a means for adjusting the tension of the springs. The commutators are of dropped forged copper bars, and are drawn up under pressure. The frames are so arranged that they may be mounted in any position on the ceiling, wall or floor, or for direct connection with back gear, etc.

A GERMAN UNIVERSAL GEAR-CUTTING MACHINE.

The accompanying half-tone, Fig. 1, illustrates a gear-cutting machine made by J. E. Reinecker, of Chemnitz-Gablenz, Germany, which has a remarkable range of adjustment and capacity for various kinds of gears and for various systems of production. It will cut worm, spur and spiral gears, the first of the usual or of the Hindley type and for worms perpendicular to the wheel axis or inclined thereto at any angle less than 30 degrees, and the second and third by either the ordinary form of gear-tooth cutter or by the generating process in which a hob inclined to the gear axis is fed across the face of the gear blank while the latter slowly revolves past the cutter. The adaptability of the machine to the generating process as applied to spiral gears is, however, an incidental outgrowth of its general design and because of patent complications, it cannot be thus used in Germany. In the use of the machine for cutting spur gears, the generating or hobbing process is preferred when large numbers of duplicate gears are required, the use of a formed cutter being restricted to those cases in which but few gears of the same pitch are required or in which the pitch is abnormal in size.

The generating process requires but one

FIG. 2. SPECIMEN OF WORK DONE ON THE UNIVERSAL GEAR-CUTTING MACHINE.

hob for all gears of the same pitch, this hob being similar to a worm hob. The cutter and blank rotate continuously until the work is finished, the rate of feed being determined by change gears. The axis of the cutter is inclined by an angle equal to the angle of the thread to the wheel plane, but the direction of feed is parallel with the axis of the gear blank when cutting spur gears and inclined thereto when cutting spirals. The stop and quick return

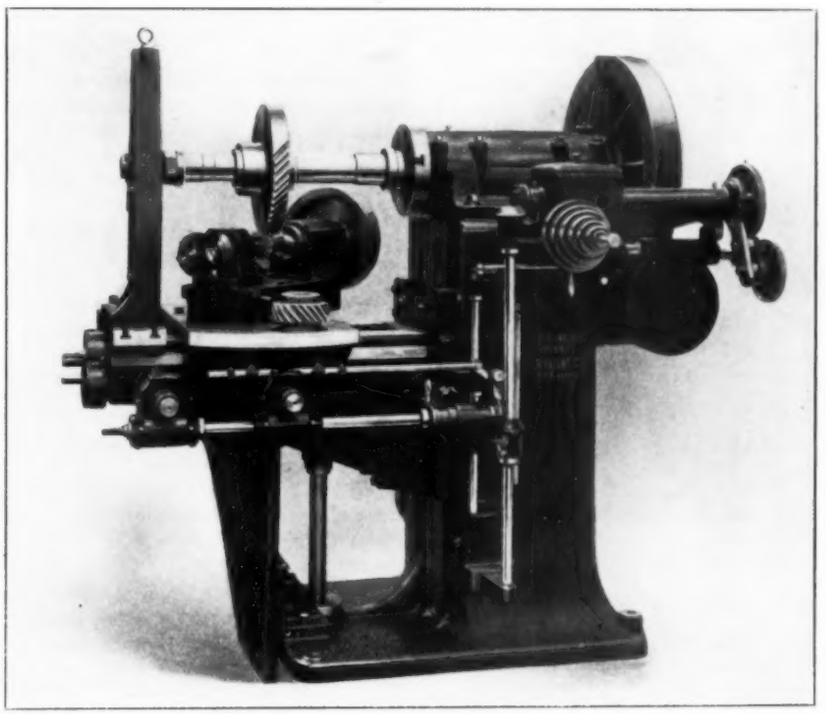


FIG. 1. REINECKER UNIVERSAL GEAR-CUTTING MACHINE.

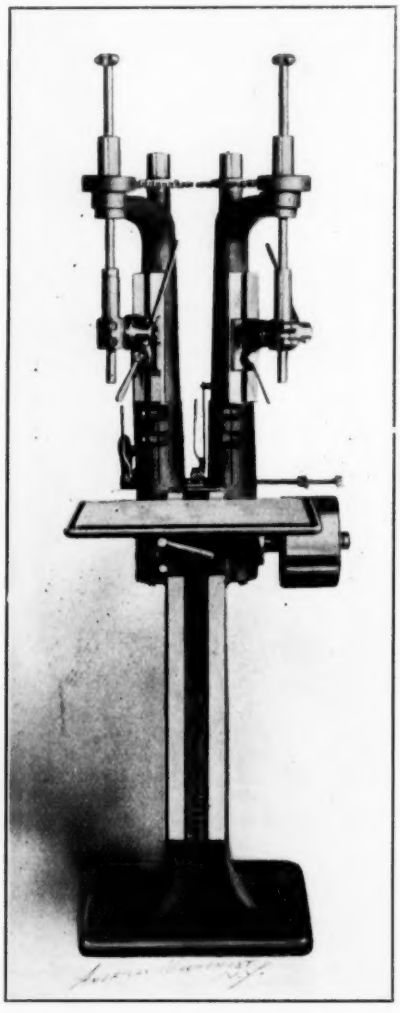
are automatic, the indexing being by hand.

The action when cutting worm wheels does not differ from what is usual, the feed being perpendicular to the axis of the blank. The feed is automatically disengaged when the cutter reaches the correct depth.

Fig. 2 shows a specimen worm-wheel made upon the machine.

TWO-SPINDLE SENSITIVE DRILL.

This two-spindle drill was designed especially for manufacturing purposes, altho it is handy for toolroom work, as it is very quickly adjusted. The top columns can be swung to different positions, making a very handy feature for jig work, as it



TWO-SPINDLE SENSITIVE DRILL.

is possible to drill two holes simultaneously or one at a time without moving the jig. Each of the spindles has three changes of speed independent of the other. The speed is changed by means of sliding gears controlled by a lever which is operated from the front of the machine. The spindles being driven thru gearing, only one belt (that to the driving shaft) is used. The machine has a capacity for drills up to ½ inch, and is made by the Fenn-Sadler Machine Company, Hartford, Conn.

The Tunnel Under the Hudson River.

In the *Engineering News* of November 10 is an intensely interesting article on the Hudson River tunnel. This article is editorially commented upon in the same issue. There have been several unsuccessful attempts to construct this tunnel. It was first started in 1874, but was abandoned after an enormous amount of money had been spent. Another attempt was made by a British syndicate in 1889. The sum total of these efforts was the completion of a single-track tunnel nearly across the river.

The conditions to be contended with in the building of this tunnel are unique, the difficulty being, not that the material to be excavated is too hard, but that it is too soft. Tunneling methods heretofore in vogue have been entirely unfitted to deal with the semi-fluid silt underlying the Hudson River. This semi-fluid mud has so far baffled every engineer who has tackled this tunneling proposition by the usual methods. DeWitt Haskins spent several years' time and a large part of Trenor W. Park's fortune in completing 2,000 feet, when it was abandoned by both engineers and capitalists. A million and a half of dollars was subsequently spent upon it by the English corporation, when it was again abandoned and work was not resumed upon it until a lapse of thirteen years.

The work is now being pushed under the direction of Charles M. Jacobs, the engineer of the New York & New Jersey Railroad Company. The methods employed were originated by him, and consist primarily of a large shield which by means of powerful hydraulic jacks is forced right thru the silt, the workmen following up with 24-inch sections of gray-iron tunneling. The work is being advanced at the rate of nearly 50 feet per day of twenty-four hours. There is no dirt to be removed, the shield piercing the silt like a huge earth worm and pushing it aside and upward.

A High-Speed Steel Failure.

A certain large twist-drill manufacturing company received an order for twist drills made of Novo high-speed steel. They were shipped and soon there was a complaint from the customer. He could "get no results from them." "They were no better than common drills," etc., besides the cost was outrageous. Upon investigation they found the customer was using the drills in a hand-driven ratchet!

The Westinghouse Electric & Manufacturing Company provided on November 2 what can only be adequately characterized as a magnificent entertainment for the visiting members of the Iron & Steel Institute. They were shown thru the works in the afternoon, and a banquet was given in a portion of the main building in the evening. Special illumination was provided by Bremer lamps overhead and Cooper Hewitt lamps at the sides. Great quantities of choice flowers were used for decoration, and each guest was given a unique souvenir, an induction motor small enough for the vest pocket. Six hundred persons participated.

The New York State Civil Service Commission announces examinations to be held December 3 for a large number of positions, among which are those of electrical engineer, assistant steam engineer and gas meter tester. Applications must be made before November 28. Full particulars and blank forms of application may be obtained by addressing the Chief Examiner of the Civil Service Commission, Albany, N. Y.

Technical Publication.

"Self-Propelled Vehicles." Second Revised Edition. By James E. Homans. 652 5½x8-inch pages, with 460 illustrations. Theo. Audel & Co., New York. Price, $2.00.

The author tells us in his preface that he has prepared this book "for the practical information of such persons as have neither the time nor the inclination to delve deeper into the subtleties of mechanics than the construction and management of their own machines require." While this purpose has been well carried out, the book is by no means of the superficial character that might be inferred. On the contrary, it is a treatise on the automobile, taking up in turn the principles of the driving and steering mechanisms, of the frames, springs, wheels, tires, brakes and bearings which are common to all types of machines and following this with excellent explanations of the action and construction of gasoline, steam and electric motors. All these features are copiously illustrated by engravings of various makes of carriages. The book is packed with information, and the automobilist who is so well informed as not to find much of interest in it is well informed indeed, while the novice and new enthusiast will find it to be a mine of information. The latter will indeed find his interest stimulated to a high degree and will also acquire an increased respect for his machine and its makers as he learns of the number and perplexity of the problems that have called for solution before the machine which obeys his hand so perfectly was evolved. Possibly also, instead of impatience at its occasional failures, he will acquire a feeling of wonder that it works at all.

Personal.

Gorham C. Parker has resigned his position as superintendent of the Superior Tap Company, of Springfield, Vt.

William F. Hoffman has become foreman with C. D. Juvenal & Co., of Springfield, Ohio, makers of telephone instruments.

C. E. Page, for some years with the Goulds Manufacturing Company, Seneca

Falls, N. Y., is now superintendent of the machine shop of the American Road Roller Company, Groton, N. Y.

Charles Lang, formerly with the Wheeler Condenser & Engineering Company, has joined the sales department of the A. D. Granger Company at the New York office, 95 Liberty street. Mr. Lang will make a specialty of pumps and condensers, the Granger Company having recently acquired the agency for the Barr Pump Company, of Philadelphia, Pa.

Obituary.

Joel Farist, president of the Farist Steel Company, died at Bridgeport, Conn., November 12, seventy-two years old. Mr. Farist came to this country from Sheffield, England. He founded and was president of the Bridgeport Crucible Company.

William Arthur Heywood, general manager of the Pennsylvania Iron Works, Philadelphia, died in that city, November 13. Mr. Heywood was a native of England and was first employed in Philadelphia in 1885 in connection with cable-car service. In 1891 he took charge of the plant of the Baltimore Traction Company, returning to Philadelphia three years ago. Mr. Heywood had been a member of the American Society of Mechanical Engineers since 1893.

Business Items.

In the construction of the extension of the Chicago drainage canal much machinery is used, including two Rand Imperial type 10 air compressors, each having a capacity of about 2,000 cubic feet; thirty-two No. 3½ "Little Giant" Rand drills, furnished by the Rand Drill Company.

The battleship "Connecticut," which was launched in September, will have the largest electric light and power plant ever installed on such a vessel. The plant, which has a capacity of 800 kilowatts, consists of eight Crocker-Wheeler generators direct connected to Forbes marine type engines.

The S. Obermayer Company, Cincinnati, O., manufacturer of foundry facings and foundry supplies, has secured contract from the United States Navy Yards, New York and Cavite, P. I., for foundry facings and foundry supplies to be used during the coming year at both of these navy yards.

Among recent sales of dynamos and motors built by the Northern Electrical Manufacturing Company, in brewing work, are extensive equipments supplied to the Kranz Brewing Company, Findlay, Ohio; Indiana Brewing Company, Indiana, Pa., and the Olympia Brewing Company, Olympia, Wash.

The Electric Controller & Supply Company, Cleveland, O., has been awarded a gold medal for its St. Louis exhibit. The apparatus shown consists of a full line of its regular controllers for crane, charging machine and similar service, a working exhibit of a magnetic switch controller built for motors of any horse-power, magnetic friction and stop brakes, cushion type solenoids, electric lifting magnets for plates, billets, etc.; resistance banks, knife switches, and a working exhibit of its direct-connected variable-speed motor drive for planers.

Manufacturers.

The plant of the Keasey Pulley Company, Toledo, O., has been burned.

The Carlisle (Pa.) Body & Gear Works has become a stock company.

The Gulf Refining Company proposes to build a plant at Houston, Tex.

The Northfield, Vt., electric power house, owned by the town, has been burned.

The Superior Coal Company, Wellston, O., will build repair and machine shops.

The foundry of the Brown-Corliss Engine Company, Corliss, Wis., has been burned.

The Madisonville (Tenn.) Knitting Mills have changed owners and will be doubled.

There is some talk of the Rock Island's shops at Little Rock, Ark., being enlarged.

The American Horse Shoe Company plans to build a branch factory at Hamilton, Ont.

The contract has been let for a large new plant for the Hollenbeck Press, Indianapolis, Ind.

Bowe, Jamieson & Co., founders, Hamilton, Ont., have taken out a permit for an addition.

The Commercial Club, Marion, Ind., is raising a subscription to secure a starch factory.

Crotwell Bros., Bessemer, Ala., will erect a planing mill and wood-working establishment.

The Adler Organ Company, Louisville, Ky., will build a $250,000 piano factory next spring.

It is reported at New Castle, Ind., that a plant of the Chicago Steel Company has been burned.

The Heminway & Bartlett Silk Company, Watertown, Conn., will enlarge its factory next spring.

The Thermopolis (Wyo.) Electric Light & Power Company intends to build a new water-power plant.

Alterations and additions will be made to the plant of the American Pulley Company, Philadelphia.

The Dayton (O.) Reduction Company will build a new plant for taking care of the city's garbage.

The Sterling Glass Company, Cincinnati, O., manufacturer of cut glass, proposes to build a new plant.

At Sioux City, Ia., there is a movement to build an electric light plant, with which J. W. Hallam is conversant.

It is understood that the Otto Gas Engine Works, Philadelphia, Pa., now plan to build a large plant near Chester.

The Gilbert Knitting Company, Little Falls, N. Y., expects to install generators utilizing the water-power.

It is rumored that the J. I. Case Threshing Machine Company will build a large plant at Fort William, Que.

The St. Mary's Torpedo Company, Toledo, O., has commenced the erection of a new factory near Montpelier, Ind.

The plant of the Watson-Stillman Company, hydraulic machinery, at Aldene, N. J., has been badly damaged by fire.

The patterns and pattern room of the Friction Pulley & Machine Works, Sandy Hill, N. Y., have been damaged by fire.

The National Fire Proof Roofing & Paint Company will, it is said, establish a plant in the village of Pleasant Prairie, Wis.

The Bacon & Collins Supply Company, Albany, Ga., has secured a site for a foundry and machine shop to cost about $25,000.

The contract has been awarded for the erection of a factory building for F. W. Coons, manufacturer of wire goods, Troy, N. Y.

The Tuthill Spring Company, Chicago, Ill., has bought a plot of 27,000 square feet and will erect a building covering practically the whole.

David Lupton's Sons Company, manufacturer of galvanized cornices, Philadelphia, Pa., is having constructed an addition, 85x200 feet.

The Pennsylvania Railroad will, it is reported, erect shops at Renovo, Pa., doubling the capacity of the present shops, at a cost of $300,000.

A new $1,000,000 power station is proposed for the merged Fort Wayne (Ind.) & Southwestern and Wabash Valley electric lines at Fort Wayne.

The Livingston Manufacturing Company, stone-working tools, etc., Rockland, Me., is to build an addition for forging and machine shop purposes.

Nathan Schee, of Oskaloosa, Ia., will open a factory at Des Moines to make wagon boxes, scoop boards, lawn swings and cement building blocks.

Upwards of $300,000 will be expended by the Boston & Maine Railroad Company on its grain elevator to be erected at Mystic wharf, Charlestown, Mass.

C. J. Bates, manufacturer of ivory, bone and steel fancy goods, Chester, Conn., is making improvements to a factory building which he has bought.

It is reported that the United Railroads of San Francisco, Cal., are about to erect shops where all of their cars and other equipment will be manufactured.

The Riverside Self-Sharpening Plow Company has purchased property in Oklahoma City, Okla., from F. M. Riley and will locate its factory upon same.

The plant of the Mersereau Metal Bed Company, Jersey City, N. J., has been damaged by fire, which affected the paint shop, polishing-room and engine-room.

The Hilbert Machine Company has applied for a permit to erect a two-story factory building at Colerain and Central avenues, Cincinnati, O., to cost $6,000.

Hanson Brothers, manufacturers of automatic screw machines, Plainville, Conn., have purchased a building on Whiting street and will use it for factory purposes.

The Globe Iron Works, manufacturer of the White gasoline engine, has lately moved its entire plant and office from Minneapolis to Menomonie, Dunn County, Wis.

Plymouth, O., has raised a bonus proposed by the promoters of the Sandusky, Norwalk & Mansfield Electric Railway to secure the power-house, car barns, offices, etc.

Ed. Knapp, of Manchester, Ia., is opening a carriage trimming factory at Ft. Dodge, Ia., to be known as the Ft. Dodge Top Company. Later he may build vehicles.

The Pease Engine & Machine Works, manufacturer of gasoline engines, Goshen, Ind., has just built a larger machine shop.

Twenty acres of land on the outskirts of Sayre, Pa., have been purchased by C. F. Dyer, of Wilkesbarre, and the erection of a feed and flour mill will soon be started.

The United Electric Light & Power Company, Baltimore, Md., plans the erection of one of the largest electric light and power generating stations in the United States.

The E. D. Jones & Sons' Company, Pittsfield, Mass., manufacturer of mill machinery, has received a permit to erect a new building for manufacturing and storage purposes.

The Rochester, Syracuse & Eastern Railway Company is to build a large power-house at Lyons, N. Y., and it is presumed that big repair shops will accompany it.

The Electro-Dynamic Company, electrical engineer and manufacturer, is moving its establishment from Philadelphia, Pa., to Avenue A and North street, Bayonne, N. J.

The Young Men's Business League, Greenville, Miss., has secured a site for a furniture factory whose promoters are Messrs. Humphreys and Scheske, the former a resident of Battle Creek, Mich. The factory has now an order for 2,000 patent extension tables.

It is stated at Lovell, Wyo., that Byron Sessions, president of the Mormon stake there, announces that his people will next spring build an $800,000 beet sugar plant. The Utah Sugar Company, of Salt Lake City, Utah, is said to be behind the enterprise.

A large plant is to be built at or near Wilmington, Del., by the Brandywine Brick Company. The officers include George M. Clothier, of Philadelphia, president; W. J. Peall, vice-president and general manager; John N. Carswell, secretary and treasurer.

It is believed that a favorable result will come of the negotiations between the Endicott (N. H.) Land Company and the Alston Stone Machine Company, which may erect a plant at that place. The concern will manufacture stone-sawing and stone-dressing machinery.

It is rumored that H. S. Kerbaugh, incorporated, Philadelphia and elsewhere, the railroad contractor, has purchased 125 acres of land in Antis township, east of Altoona, and along the Pennsylvania railroad, and will erect a plant thereon for building cars and other things.

A new packing plant costing $2,000,000 will, it is reported, be built at Kansas City. C. F. Morse, president of the Kansas City Stock Yards Company, is quoted as admitting that he is posted on the matter but not at liberty to divulge the name of the company that is to build the plant.

It is stated at Portsmouth, O., that Eugene E. Knox and some associates, all local men, expect to manufacture telephones. They have secured some of the patent rights of the late Thomas C. Drake, an inventor, who died at McConnelsville, O., in September, and will transfer his plant to Portsmouth.

It is stated at Shelbyville, Ind., that the members of the Vandegrift Wrench Company, whose plant was recently destroyed by fire, have decided to rebuild on the old site. Meanwhile the company has been looking for temporary quarters in which to begin manufacturing, having many orders booked.

A street car factory has been started at South Milwaukee, Wis., by Henry Romunder, of Newark, N. J. The old Stollenwerk factory building is being used for the present. Steel is employed quite extensively in the body construction. The work of building the new cars is in charge of W. A. Stoerzer, of Milwaukee.

Director Harry Moore, of the public safety department, Pittsburg, Pa., is quoted as saying that in case the sale of the engine-house near the Point to the Wabash Railroad is consummated, it is the intention for the city to erect a fine machine shop for the fire bureau on Carson street, above First street, South Side.

The Boiler Compound Company has been incorporated by Charles A. Wilkinson, James Melhuish, Frank L. Dennis, George E. Green and Carroll E. Reynolds; capital stock, $60,000. It will manufacture silver solder for bandsaws, belt dressing and boiler compound. The factory will be located on Wall street, Binghamton, N. Y.

The Manufacturers' Association of Pittsburg at its late annual meeting elected: President, W. H. McFadden, of McIntosh-Hemphill Company; vice-president, H. C. Shaw, of the Garrison foundry; treasurer, Stewart Johnson, of the Pittsburg Steel Foundry Company; councilors, W. C. Scott and Edward Kneeland, of the Frank-Kneeland Machine Company.

The Geo. W. Bowers Manufacturing Company, of Boston, Mass., has been incorporated under the Maine laws to take over the manufacture of the Bowers file and tool holder and the thief-proof cabinet, formerly manufactured by Geo. W. Bowers, of Waltham, Mass. The officers of the company are Leonard J. Schuler, president; Wm. H. Barstow, treasurer; Robt. S. Earhart, secretary, and Geo. W. Bowers, manager.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper chs. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A practical book, "Dies and Diemaking," post paid $1. J. L. Lucas, Bridgeport, Conn.

Steel name and monogram name stamps; diesinking; write for estimates. J. L. Lucas, Bridgeport, Conn.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Write for price on only machine shop, boiler shop and foundry in Black Hills. J. C. O'Donnell, Deadwood, S. D.

Electric motors and apparatus calculated and designed by competent engineer. Room 223, 45 Broadway, N. Y. City.

Wanted—Gentleman with $10,000, to act as sole sales agent for a new machine tool. C. S., care AMERICAN MACHINIST.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

Wanted—All kinds of experimental work and model making; we also make a specialty of all kinds of die work. Walker Tool Co., Lansing, Mich.

Wanted—Partner in machine shop; $1,600 will buy half interest; situated in central Michigan; man to be able to take charge of shop. Box 556, AMERICAN MACHINIST.

Dental Burs.—Wanted—Mechanic, designer or maker, to supply automatic machines for cutting teeth on above; all replies strictly confidential. Box 548, AMER. MACHINIST.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

A German mechanical engineer who traveled 2 years in America would like to have an agency for an American firm for Germany. Wm. Steinhorst, 61 Zschochershe str., Leipzig, Plagwitz, Germany.

Will buy foundry or machine shop in Connecticut or New York. I have the experience and backing and want to furnish additional capital to going concern, buy half interest or the entire plant. What have you? "R.," Box 555, Wellsburg, W. Va.

For Sale.

For Sale—Whole set of instruction papers, examination work of mechanical engineer of I. C. S. 3145 Edgemont st., Philadelphia.

For Sale—A Whiton hand feed gear cutting machine, in first-class condition; price, $150. Address Frank Rettinhouse, Norristown, Pa.

For Sale—One Pedrick & Ayer portable pneumatic riveter; a first-class machine, used but a short time, and in good condition. Address "Riveter," care AMER. MACHINIST.

For Sale—One No. 9 Blake & Johnson double geared rolling mill, diam. and face of rolls 10x15 in.; in A1 condition; never used. Bausch & Lomb Optical Co., Rochester, N. Y.

For Sale—1 Farrel Foundry hydraulic pump and press; 800 tons; cost $1,950; will sell very reasonable; perfect condition. H. M. Crowell Mfg. Co., 6th ave. and 13th st., Newark, N. J.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price, and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute; 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway, New York city.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of adveriser, nothing else.

CONNECTICUT.

Position as manager or superintendent; have had wide experience; can furnish very best reference. Box 555, AMER. MACHINIST.

ILLINOIS.

Mechanical draftsman, college graduated, wants position; has practical shop experience; will go anywhere. Box 584, AM. MACH.

A practical machinist, tool and die maker, of large experience in all branches, handling of help, system of shop drafting, etc., at present foreman of electrical shop, wishes to change; west of Mississippi preferred. P. F. Schroder, 458 W. Cornelia st., Chicago, Ill.

Do you need an experienced traveling salesman with technical education and considerable shop practice? Will be open for engagement January 1st. Mining machinery preferred, but will accept heavy machinery and mill supplies. Address F. No. 1, 956 Monadnock Bldg., Chicago.

INDIANA.

Thorough mechanic, cost reducer, inventive, progressive, broad experience in designing tools and methods for duplicate manufacturing in up-to-date manner, is open for position of responsibility; perfectly willing to demonstrate ability to sound, live firm; toolroom, general foremanship or superintendent. Box 496, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes to change. Address Box 568, AMERICAN MACHINIST.

Foundry foreman, 14 years foreman, is open to engagement; dry and green sand; heavy and light castings; mixing iron by analysis. Address Box 578, AMER. MACH.

Skilled toolmaker and draftsman, rapid calculator, wants work; have designed some very fast automatics; if you have some new and original machinery to design, let me suggest the way. Address Box 562, AM. M.

Mechanical engineer, technical graduate; steam and power plants; building, heating and ventilating; electric light and power; mechanical engineer of large manufacturing plant, in charge of engineering, construction, repairs and operation. Box 570, AM. MACH.

MICHIGAN.

Superintendent wants to change; is O. K. Address Box 589, AMERICAN MACHINIST.

Expert mechanical draftsman, rapid, accurate, good knowledge of engineering and strength of materials, experienced in machine design is open for engagement where thorough work is required and where correspondingly liberal salary is paid. Address Box 540, AMERICAN MACHINIST.

NEW JERSEY.

Experienced foreman patternmaker desires change; A1 references. Box 591, AM. M.

Mechanical draftsman wishes position; N. Y. city preferred. Box 552, AMER. MACH.

Machine and tool designer wants position; can hold position as general foreman or superintendent. Address Box 481, AM. M.

Notes From the Jones & Lamson Shops.

EDITORIAL CORRESPONDENCE.

ISOMETRIC DRAWINGS.

In the last few years quite a number of articles on this subject have appeared in the AMERICAN MACHINIST. While having had, personally, no actual experience either in making or using such drawings, articles perused at different times and information gained during visits to various machine shops and drafting offices have led me to believe that the isometric principle in drafting might be utilized to great advantage in many places, whereas at present it is but very infrequently used.

W. R. Bryant, chief draftsman at the Jones & Lamson shops, is a staunch advocate of the isometric drawing, and during a recent conversation with him in Springfield I learned that the J. & L. draftsmen have made, from time to time, quite a number of such drawings. The shop foremen like them, and the men after becoming accustomed to them, find them very convenient to work to. The draftsmen with but a limited experience in laying out at the isometric angle lines which customarily are drawn horizontally or vertically, soon acquire the ability to do this rapidly, and it has been found at the above drawing room at least, that isometric views are made with almost as great facility as the ordinary drawings. Consequently, many of their machine details are laid out isometrically, and also many jigs and fixtures are so drawn, and altho, when a tool or machine is to be drawn up in a great hurry, the regular drawing has been found just a little easier and quicker to make, the actual difference in the time required between the two types of drawings is nowhere near so great as the uninitiated might expect.

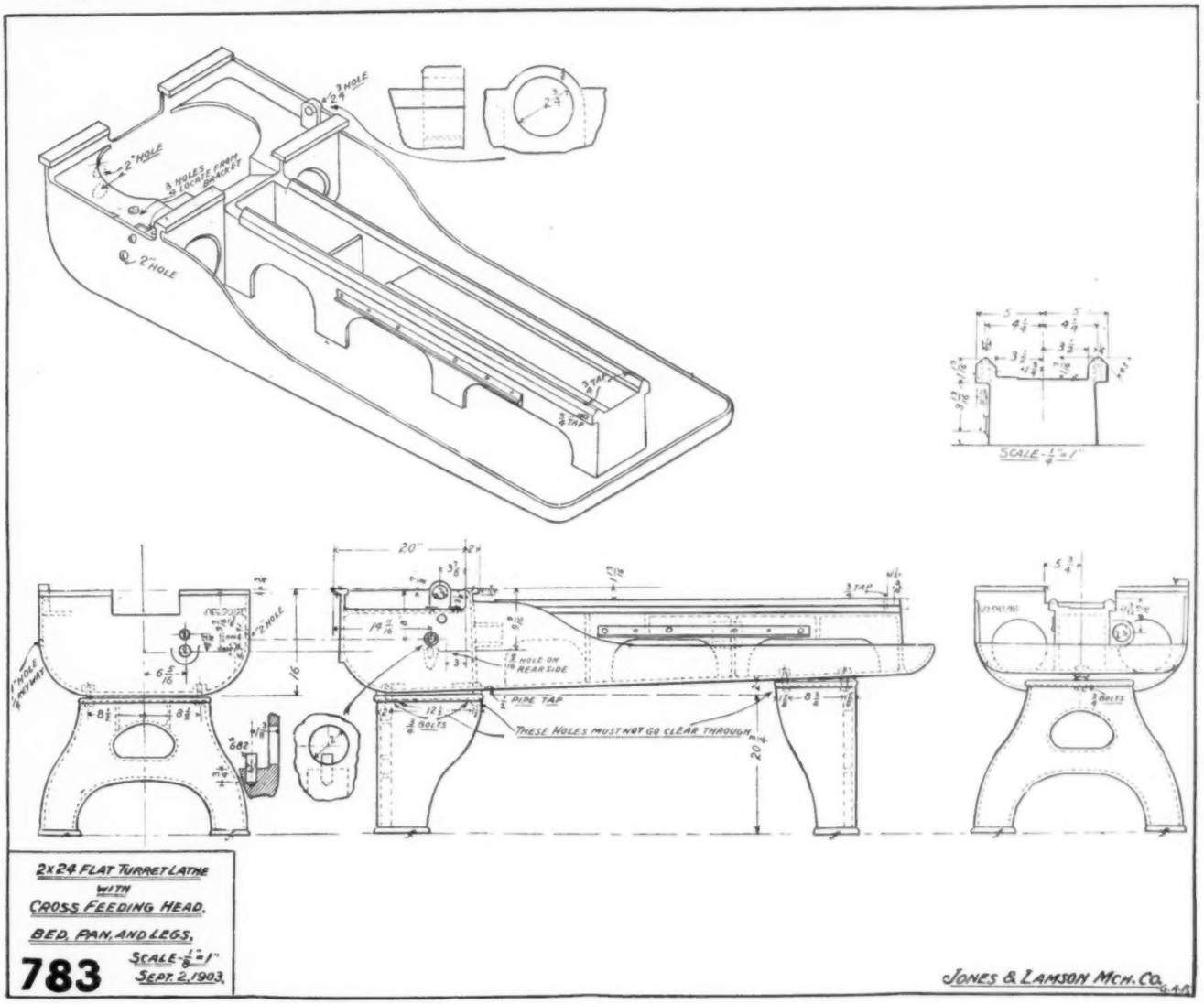


FIG. 1. DRAWING OF "2X24" BED, PAN AND LEGS.

In Fig. 1 is reproduced to about one-third size a drawing of the bed, pan and legs of the new model 2x24 flat turret lathe. This drawing, it will be observed, combines both standard and isometric projection, the three elevations being laid out in the usual manner while the plan is replaced by a neat isometric view. While very few dimensions are placed on the latter, it nevertheless adds greatly to the facility with which the drawing is read and shows more clearly than could any one view (except possibly a true perspective) or even a dozen views, the outline of this interesting casting. In the engraving all dimensions have been left on the different views to show the thorough manner in which this drafting office attends to the finishing of its drawings and to the putting on of all necessary figures.

CHUCK HOLDING SCHEME FOR "2 X 24."

Fig. 2 shows the ingenious method by which the 12-inch chuck is secured to the spindle of the 2x24 flat turret lathe. As noted in a recent article on the latest design of this machine, the spindle is practically straight from end to end in both sizes; that is, in both 2x24- and 3x36-inch machines. Both spindles are of the same outside diameter, but in the case of the larger the nose is threaded to receive the automatic chuck for bar stock, or the scroll clutch for large work; in the case of the smaller spindle, an entirely different scheme is employed for attaching the chuck. This spindle is bored out at the end to receive the regular automatic chuck jaws, the only addition made exteriorly

being the sliding member for closing the jaws upon the work. Therefore the nose of the spindle is finished cylindrically and without the thread employed on the larger

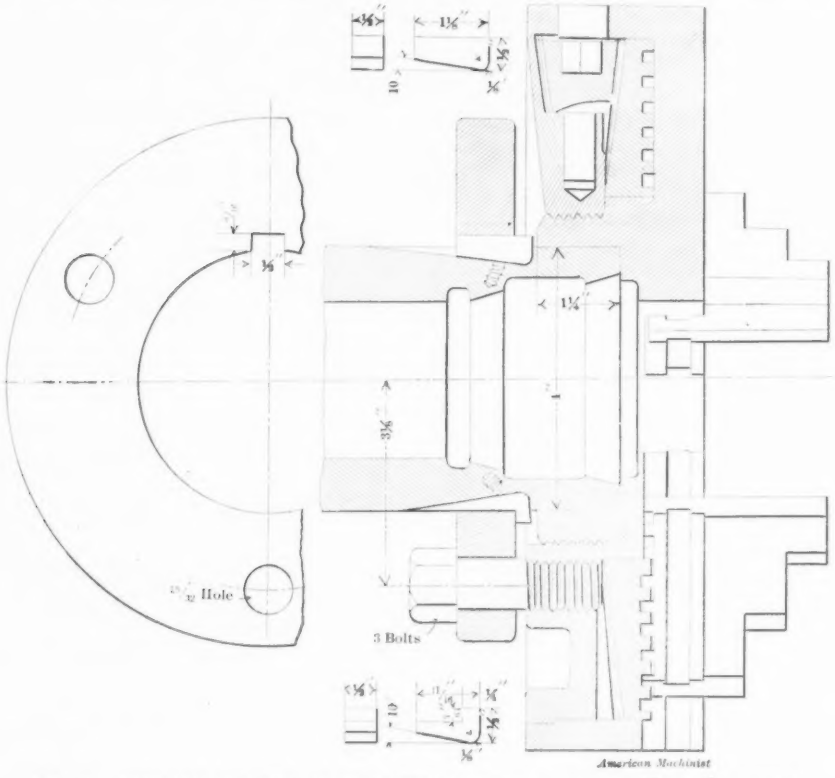


FIG. 2. SHOWING METHOD OF MOUNTING 12-INCH CHUCK ON "2X24" SPINDLE.

size. To place the large chuck in the position shown, the automatic-chuck closer sleeve is removed and the six pawls or fingers which serve to operate this sleeve are taken from their pockets and replaced by six keys, two of which may be seen in the sectional view. Five of these keys are provided with heads and against these heads abuts a gray-iron face-plate to which is bolted the chuck and which serves to draw the latter back snugly into position with the chuck seat tight against the true end of the spindle; the sixth key, shown at the top of the spindle, acts as the driver.

While the change from the automatic to the three-jaw chuck is easily made in this manner, the latter chuck can be mounted, if desired, on the head of a plug whose shank is adapted to fit the regular bar chuck; and for work of moderate size I believe the chucks are usually so mounted.

A MULTIPLE TOOL HOLDER.

In Fig. 3 are shown three views of a novel and efficient multiple tool holder forming part of the flat turret lathe equipment and designed especially for use in facing chucked work. This tool is clamped to the turret top in precisely the same manner as the standard turning tools; it carries, as shown, six reversible cutters, and tho only one set-screw is used for clamping the six tools, each of these nevertheless gets the full clamping effect of that screw just as if it were the only tool in the group. This is due to the fact that the five spacing strips or gibs between the tools are provided at each end with a shoulder which drops over the body of the holder and prevents the gib moving endwise relatively to either tools or holder.

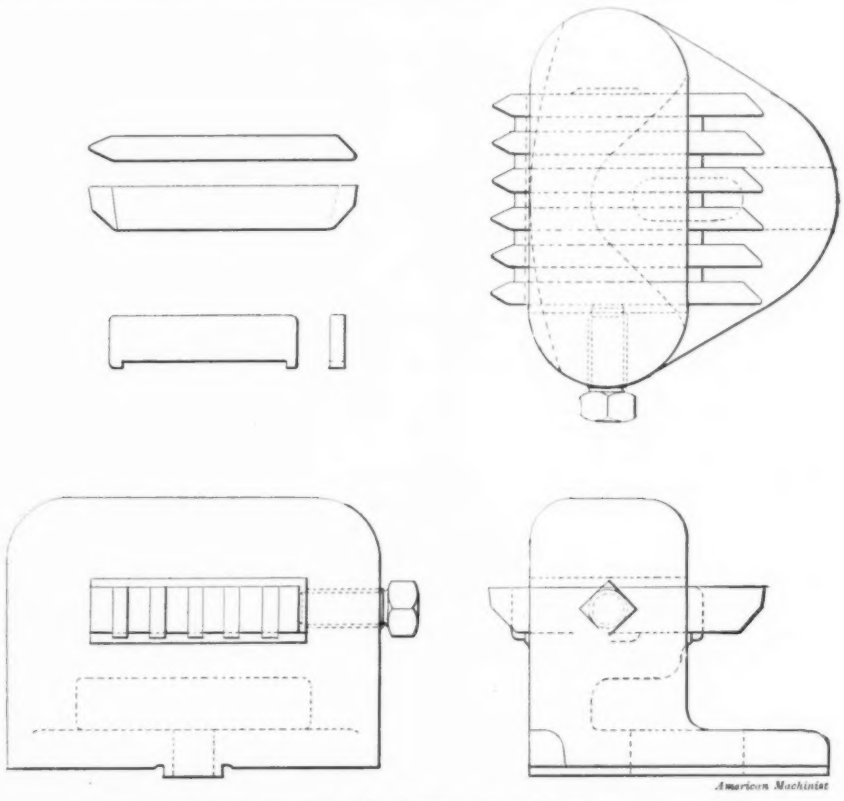


FIG. 3. A NEW MULTIPLE TOOL-HOLDER FOR THE FLAT TURRET LATHE.

With this construction, it is obvious that no matter how strong a tendency there may be on the part of one tool to shove backward in the holder, no sliding movement whatever can be transferred to any of the other tools, the gib between remaining absolutely free from end motion.

SCREW MACHINE DEPARTMENT NOTES.

Writing now of turret machine tools leads naturally to the mention of a number of interesting features in connection with the operation of the screw machine department, about which I have had more or less to say in previous articles. Every piece made in this department (as in fact every piece made in any part of the shop) has its own list number and the screw-machine foreman has a blueprint book, measuring 6x9 inches, and containing details of every piece made under his supervision, together with its list number and the material from which it is constructed. He has also a similar book containing drawings of every tool employed in his department, and when he finds it necessary to order new tools he simply refers to this book, secures the required numbers and sends them in with his order to the toolroom, whose chief from a duplicate book gets the necessary tools made.

For illustration: Let us suppose a certain tool is required for use in the chucking machine on which are manufactured the automatic chuck-jaw blanks. The list number of this blank, which, as it leaves the machine, is a cone-shaped affair, is 1038. Now, for machining it, five tools in addition to the cut-off are required. These tools are numbered, say 1038-1, 1038-2, and so on, and comprise roughing and finishing cone tools for the perifery of the chuck, a forming tool for the rear end of

the chuck, a facer for the front end, etc. If one of these tools is to be replaced, reference to the book gives its number at once, and it is ordered by that number, and very soon put in the hands of the foreman for actual use. Those who have been accustomed to seeing duplicate tools made from samples or from half-worn-out tools, can fully appreciate the advantages of this system whereby each tool is drawn out in detail so that it may be duplicated without reference to the piece itself.

Besides the two blueprint books mentioned the foreman keeps a complete set of small prints of the different parts he makes, pasted on 3x5½-inch cards, one print to each card. Every dimension is given on the print and on the back of the card in large figures is the list number of the piece. Both sides of the cards are shellacked and the operators in setting up jobs work from the cards instead of from samples.

Perhaps the most interesting feature of this department is the line of hydraulic turret lathes illustrated in recent issues. These machines are interesting not only from the point of view of the machine designer and constructor but also because of the class of work which they turn out. One piece which I saw produced on one of the hydraulics was the rack pinion shaft which carries at its outer end the pilot wheel for moving the 2x24 turret lathe carriage by hand. This piece is made from 2⅝-inch stock and is approximately 15 inches long over all. The pinion blank formed at one end is 2½ inches diameter, while the body of the shaft for the greater part of its length is 1¼ inches in diameter. A large lot was going thru at the time of my visit, and I took the liberty of testing a number of them with a micrometer. They were perfectly straight and of accurate diameter; and the turned surface was as smooth as glass.

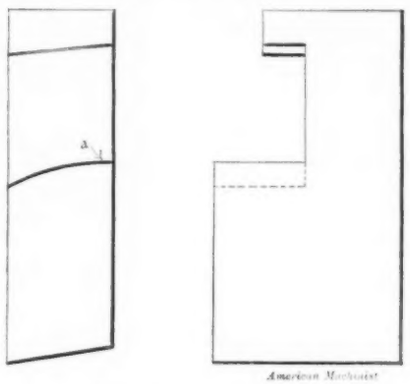


FIG. 5. CHASER BLANK FOR AUTOMATIC DIE.

AN AUTOMATIC HOLLOW MILLING MACHINE.

In the description given of the J. & L. shops, at page 709, a view is shown in the die department bringing out in the foreground an automatic machine employed for milling the cam bearing surface on die chasers. The drawing given here in Fig. 4 shows the plan and section of this machine. The blank itself is represented in Fig. 5, the surface at *a* being the one to be machined. These blanks are dropped, some fifty or sixty at a time, in a vertical magazine at *b*, Fig. 4, which magazine is mounted on a casting *c*, forming a guide for a slide *d*. The hollow mill is shown at *e* and consists of a number of cutters fitted in slots at the end of the spindle *f*, and adjusted by a thin nut at the rear. The guide for the slide *d* is placed at an angle to the axis of the spindle so that the work as it drops into this slide and is fed forward will be presented obliquely to the corners of the cutters forming the hollow mill, thus securing the proper clearance for the work as it feeds into the interior of the mill.

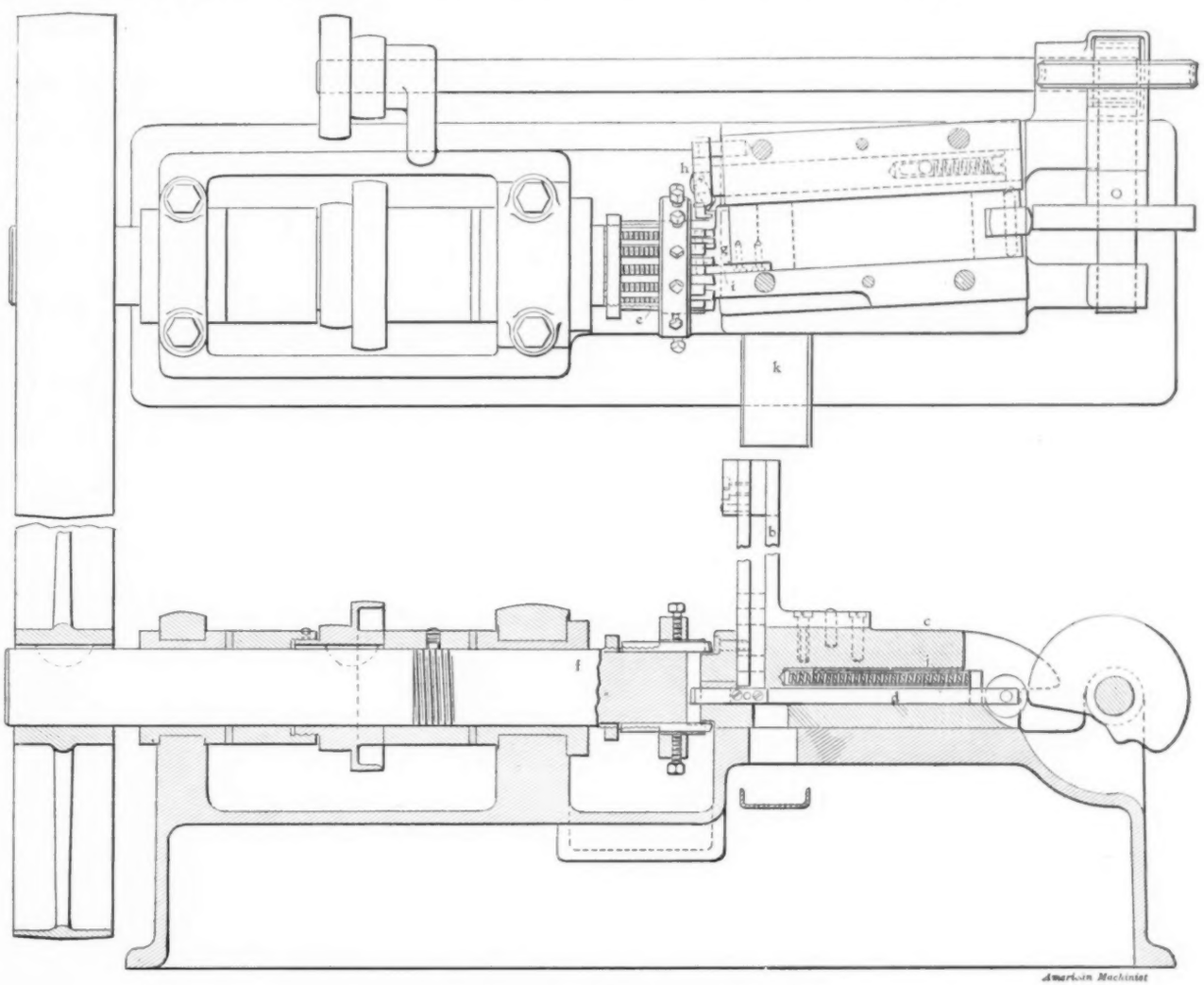


FIG. 4. AUTOMATIC MACHINE FOR ROUNDING DIE CHASERS.

The slide *d*, as will be noticed, is cam actuated, the cam shaft being driven as represented thru the worm-wheel and worm and small cone pulleys mounted on the worm shaft and cutter spindle. As the cam shaft rotates and *d* is forced forward, the blank shown at *g* is engaged by the spring catch *h* and held rigidly between that and the finger *i* at the front of the slide. The end of the feeding portion

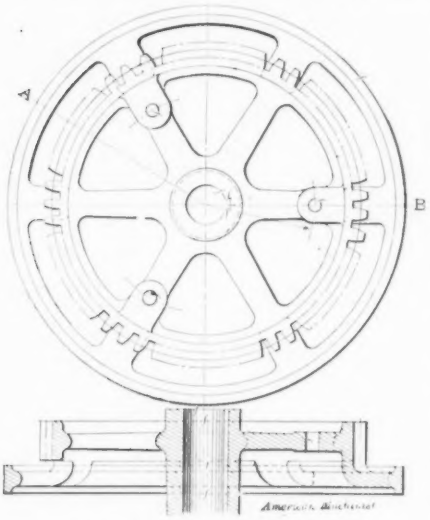


FIG. 1. A MACHINE MOLDED GEAR.

of the cam being reached, spiral spring *j* forces slide *d* back and allows the chaser blank to drop down thru the machine and to follow chute *k* to a receptacle in front of the bed. As *d* moves forward again and then comes to rest momentarily, the blanks in the magazine which have been resting upon the upper face of the slide cause the lower blank to drop into the pocket at the front end of the slide; this then proceeds forward and carries the second blank into the hollow mill.

This machine works steadily right thru the day, requiring very little attention aside from the filling of the magazine, and drops out work at the rate of about sixty pieces per hour. The machine is conveniently located relatively to a large number of other millers used in cutting up the stock for blanks, milling the cross-slot in the edge of the blank and cutting the blanks at the approximate angle for the clearance at the front end; and therefore one of the operators attending to the other machines keeps this machine filled with blanks and in operation with very little trouble and no loss of time.

F. A. S.

A "news" item says that an Englishman has replaced the ordinary grooving of a rifle barrel with lines of small ball bearings, along which the hard steel projectile slips. The inventor claims that he gets 40 per cent. greater average velocity, penetration and range than can be obtained with the same weight of projectile and charge in guns made on the old system. This is a remote promise of work for machine-tool builders.

Machine Molding a Special Gear—Fitting the Pattern.

BY W. O. SMYTHE.

The crankshaft gear, Fig. 1, goes on a silk loom. It is 14 inches in diameter and has 55 teeth. These teeth must be cast perfect, and to do this in the old-fashioned way would require a skilled molder, and at that the chances are that some dressing would have to be done to each casting; so if the casting could be made so perfect as to require no work but the drilling then a great saving would be accomplished. This can be done.

The gear is a typical stripping plate molding machine job, and if properly put on the right machine it will be a success and ought to be turned out 50 per cent. cheaper than by hand molding, saying nothing of the saving in chipping and trimming the casting. It is possible to ram the sand around this gear by power, thereby securing a still greater saving.

In Fig. 2 I show in section the drag parts of the gear pattern and the necessary plates mounted on the drag machine. *B* is the gear and arm part of the pattern, *C* is the stripping ring for the *B* and *D* sections of the pattern, *D* being the outer ring of the pattern, the top surface of it coming flush with the top surface of the stripping plate. The broad outer face of *D* is made in the cope, therefore it is mounted on the cope machine and is marked *Q* in Fig. 3. I show also an ' on flask mounted on the cope machine, and as the parting line of the pattern is so near the middle of the casting it allows about an equal portion in cope and drag

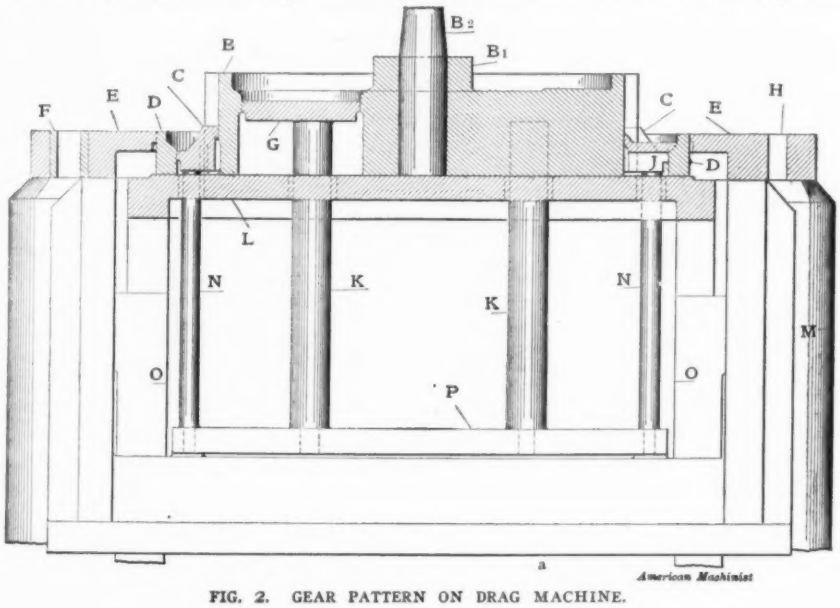


FIG. 2. GEAR PATTERN ON DRAG MACHINE.

and therefore the drag section of the flask can be the same as the cope, one pattern for both. On the cope pattern around the side of the core print are four feeders marked *S P*, shown in section. They run from the face or top of hub *Z* to the end of the core print *Y* and a sprue is made to sit on top of the feeders and core print, being held in place by a small pin in the end of print *Y*. The top of the sprue comes flush with the top of the flask.

Several wood patterns will have to be made; they can be made cheaply, as they are only to be used once. The old hand method of molding required only one pattern, while the molding machine requires two, one for cope and one for drag, and often these are divided into several parts, as I will endeavor to explain. The first one will be for the drag, as that is the first part of a mold.

In Fig. 2 can be noted the parting line. It starts along the inner top surface of the outer rim *D*, following that surface over the inside edge until it comes to the center of the spokes, then between the outer rim and the next nearest part of the pattern, the gear teeth. At the under end of them is a space slightly elevated above the parting line of the inside of outer rim *D*. It would not do to make the parting line between these two points on one straight line, as it would be liable to leave a fin or seam on the casting; so we step back from the parting line of rim *D* about 3-16 inch, then up on an angle of 45 degrees, until in line with the lower end of the gear teeth. This will bring it about 1-16 inch away from the end of the teeth, then right into the bottom of the teeth. This ring that makes the parting line from *B* to *D* is marked *C* and acts as a stripper to the teeth in gear *B* and also strips *D*, and where this ring *C* crosses the spokes there is fastened to the ring one-half of the spoke; this is marked *J*. One end of the section *J* is formed to the shape of rim *D*, while the other end is left slightly projecting upward and formed into the teeth of gear *B*, acting as a stripper to the long teeth at each spoke. *J* is fastened firmly to *C*. To further trace the parting it is necessary to start at *P L*, Fig. 3. This point, as may be seen in either Fig. 2 or Fig. 3, is where the 45-degree parting line stopped 1-16 inch away from the end of the gear tooth. From there the parting

line continues along the lower face of the gear and over the inside of the gear until it comes to the center of the spokes, then continues on that line to the center of the pattern. The plates *G* and *W* form the parting line. In Fig. 3 will be noticed *J J* in section; this is the cope section of the outer short spoke which connects the outer rim and the gear. *J J*, Fig. 3, and *J*, Fig. 2, form the entire spoke. This section *J J* is made separately and is fastened to the cope pattern after the babbitting is finished; otherwise the plates and patterns could not come together properly. The hub of the gear is made in two pieces, *B*1 and *Z*, Figs. 2 and 3, for the purpose of babbitting.

Two of the first patterns that should be made are the gear and the hub, *B* and *B*1, so make a wood pattern with allowance for double shrink and finish on parts that can be turned and for a file finish on parts that cannot be turned. When the wood pattern is finished it should be a blank like *B*, Fig. 4. A good gray-iron casting should be made and a hole bored in the hub the same size as the core print; then the two surfaces where *B* and *B*1, Fig. 2, meet should be finished and the two pieces fastened together by screws and dowel pins so that the piece can be removed when babbitting. Put them on a mandrel in the lathe and finish them up to the desired shape or size as one pattern, then have the 55 teeth cut; this gear will go on the drag machine.

The next necessary step will be to make a wood pattern for *C*, Fig. 2, allowing

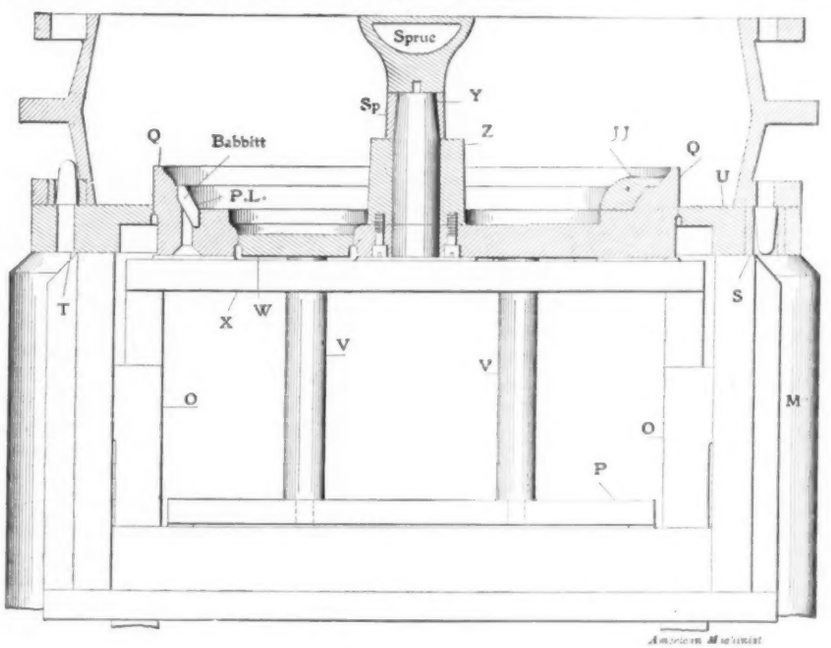


FIG. 3. GEAR PATTERN ON COPE MACHINE.

double shrink, and finish all over it; a plan of the ring is seen in Fig. 6. As it is very frail, it would be advisable to turn it up on a follow-board and as part of the follow-board and then have the mold made from it before it has time to get out of shape. Care should be taken not to dump it out of the mold too soon, so that the casting will be straight. This casting should be chucked and finished on the bottom flat surface, on the outermost surface and on the lower top flat surface which forms the parting. Then it should be clamped to a face-plate true with the outside, letting the clamps that hold it come on the finished flat top surface, then proceed to finish the remainder to the shape shown in *C*, Fig. 2. This is a blank ring the innermost diameter of which is the same as the diameter of the gear at the bottom of the teeth. The next pattern is the one marked *D*, Fig. 2. This ring forms part of the parting line. It should be chucked and finished all over. A templet can be made of the irregular parting line from the flat surface to the center of the spokes and both cope and drag patterns which require this shape can easily be made alike. The next wood pattern is the stripping plate; one wood pattern will do for both machines. This plate is to be finished on both sides and the outer shape is to correspond to the shape of the molding machine. This will make a plate with two ears, and thru these ears will run the flask pins and bushing. A round hole is cut in the center of the plate *E* a little smaller than the finished outer rim *D*, and the thickness of the plate inside the surface which would rest on the frame of the machine is ½ inch thick, while the outer surface that rests on the machine is an inch thick. This inch-thick strip all around the outer edge of the plate makes it strong and prevents it from springing. Have two good gray-iron plates made, face them and bore the hole to the shape shown in Fig. 2 and to the size of finished rim *D*. The next wood pattern will be for the pattern plate *L*, Fig. 2, one pattern for both machines. This plate also is ½ inch thick thru the center and an inch thick all around the edge; the top has chipping pieces on it wherever it is to be finished. There are to be several holes made in this plate for stools *N* and *K*. The next pattern will be the stool plate *P*. This is a plain plate ½ inch thick, finished on both sides. The stools can be made of

FIG. 4. BLANK FOR GEAR PATTERN.

cold-rolled steel and set in the stool plate. Make two castings of the stool plate, one for each machine. The next pattern is the plate *G*, this to be finished all over, so get twelve castings. The last pattern for the drag machine is *J*, Fig. 2. The width is the same as that of the spoke shown in Fig. 1. Have six brass castings made for the drag machine only. The first pattern for the cope machine will be the piece marked *Q*. This forms the remainder of the outer rim *D* and the gear *B*. The outer vertical face of the rim is to be stripped, so the depth of the casting to be used for the pattern is ¼ inch longer on this vertical face and the remainder of it is to be ⅛ inch less in diameter; this leaves less surface to finish. The total depth of the pattern *Q* is to be determined by the distance down to the pattern plate when machine yoke *O* is in its uppermost position. The hub *Z* is made separate and is fastened to *Q* by screws shown in Fig. 3. Get one good gray-iron casting, bore it to fit the mandrel used for the drag pattern, face the surface where hub *Z* fits, and after it is screwed on continue the bore clear thru and finish it to shape. The pocket for babbitting is to be cut in ¼ inch deep and as shown in Fig. 3. This pocket is cut all around the casting and section *J J* is off when turning up the pattern. Make the feeders *S P* and sprue as shown in Fig. 3.

I will now proceed to show the fitting of the parts, the drag machine first. Take plate *P* and drill it to fit the machine, using the jig that is furnished with the machine, and the same with the pattern plate and stripping plate. Set ring *D* in place and scribe its inner outline on the pattern plate, drill six or eight screw holes in the pattern plate, set rim *D* in place again and mark the holes in it, drill and tap them and fasten it on. Find the distance from the inside parting line of rim

D down to the top of stool plate *P*, then find the thickness of ring *C* from the lower flat surface to the bottom surface, subtract one from the other for the correct length of stools *N*. Locate and drill six holes, fasten in the stools, and locate and drill clearance holes where they go thru the pattern plate. Dowel pins, 1¼ inches, are inserted in ring *C* to fit into holes in the ends of the stools. Set the finished gear on ring *C*, scribe the outline of the teeth on the ring and then cut out the ring to the shape of the teeth, slightly tapering the teeth or making the opening a little larger at the bottom. The teeth of gear *B* also are filed slightly taper from the parting line to the ends of the teeth. Gear *B* and ring *C* are placed on the machine and the lever is worked to raise the gear. It is not liable to go thru at first and is eased with a file until it works freely. A nice fit is essential for a nice mold. Gear *B* is fastened to plate *L* by a screw in each spoke, and holes ¼ inch larger than the stools are drilled in *L*. Find the distance from the parting line in the center of the spokes down to plate *P*, subtract the thickness of plate *C* and this will be the length of stools *K*.

The preceding may be taken as a sketch of the process of fitting the pattern to the drag machine. The fitting to the cope machine is an operation quite similar, but requiring too much space to go thru in detail.

The outfit being complete, to make a mold proceed as follows: Raise the pattern in the drag machine to proper position, set the drag section of the flask in place, put the necessary facing on around the pattern, fill up with heap sand and ram. Turn the handle of the machine and drop the pattern out of the sand and thru the stripping plate, then lift the flask off, set it on a board on the floor and set in the core. Then raise the pattern in the cope machine to its proper place, put on the cope, set in the sprue, put in facing, fill up with heap sand and ram. Vent it, lift out the sprue, lower the pattern, lift the cope off the machine and set it on the drag. Clamp the flask, and it is ready to pour.

"Highest Award."

If there are any manufacturers in this country, making anything from a snap switch to a 1,000,000-kilowatt unit, who did not receive the "Highest Award" at the St. Louis Exposition, they are requested to send us their names and the reasons why. We expect to devote a quarter of a column to their shattered feelings in the December issue. The right is reserved to reject any remarks concerning the jury of awards. They did their best. Any excuse that the last train load of medals, in which yours was contained, was smashed up on its way to the Fair, will not be accepted for publication unless you can show the bill of lading.—*The Central Station.*

The Ideal Blacksmith Shop and Equipment for General Railroad Work.*

The ideal railroad blacksmith shop is built of structural iron encased in brick, the roof having a large factor of safety after the jarring from the large steam hammers and the support of the masts of the necessary jib cranes carrying from 4 to 5 tons each while working under a steam hammer have been provided for. The hight of the eaves from the floor line should be about 30 feet. The roof should be of the monitor design, with pivoted windows at ends and sides. Three-sash windows in the walls are preferred, the bottom sash to hoist and the top sash pivoted, thus inviting a good circulation of air.

The first consideration as to the necessary dimensions should be concerning the forges. Double forges are preferable, and most economical in floor space when placed at an angle of 45 degrees, with 15 feet from the wall to the center of the stack and 15 feet from center to center of stacks, allowing 20 feet from the center of the stack toward the middle of the shop for working room. A pair of forges and their working room will take 525 square feet of floor space, and placed at an angle of 45 degrees will be perfectly adapted to any class of work except frames and furnace work. In placing single forges along the walls there should be at least 5 feet between the wall and the center of the stack, and the space between centers of stacks and the working room the same as allowed the double forges; this making 375 square feet of floor space necessary for the single forge against 262 square feet for each forge when they are placed in pairs. The number of stacks in the single forge plan and the holes in the roof will be doubled. If stacks are not employed you have not an ideal shop, but rather an ideal smoke-house for the smoking of men. When stacks are employed, the throat of the forge hood at the stack connection, and the stack as well, should be large enough to not only accommodate the smoke and heat in their natural tendency to ascend, but to create a draft that will cause the surrender of all the smoke and a greater part of the liberated heat above the fire to its influence.

In connection with railroad blacksmith shops I have nothing to say in favor of arranging the forges in groups of four, or in trying under false pretence to hoodwink the smoke into traveling in the wrong direction. I have visited two new shops where such mistakes have been made, and I feel it someone's duty to enter protest as to the propriety of a plan that will produce an atmosphere in the shop that will simply suffocate or stifle the men who are compelled to work in it.

Some thought should be given to the storage of fuel, to convenience, cleanliness and economy in fuel and shop space. In many smith shops there is as much valuable space taken up with coal and coke boxes as is occupied by the forge. While we owe much to Tubal Cain, we should not content ourselves to-day with a hole in the hillside for a forge.

Large forges are preferably made circular, and should have sufficient space for the convenient handling of the heavy work. The frame forge should be about 36 inches square and made to drop about 12 inches. The drawing shows a forge which is counterbalanced by weights and levers at each side so that it is moved down or up quite easily. Such a forge can be dropped quickly; the slow process with the chain hoist is avoided and the fire is left in good condition for the succeeding heat.

There is quite a difference of opinion among those who should know as to the proper volume and pressure of blast necessary. Many claim that a great volume of air with a pressure of 5 to 7 ounces is best but I have determined to my satisfaction that any volume that will fully supply each forge with a constant pressure from 14 to 16 ounces thru an upright opening in the tweer equal in area to 2 or 2½ square inches is about the proper thing for railroad smithshops. Seven ounces of blast pressure, no matter what the volume, will not heat iron as rapidly as the iron will absorb the heat, and consequently we do not get a maximum output, while with 14 to 16 ounces, regulated to suit the conditions, every heat unit up to the limit of absorption in the iron can be utilized, and the earnings of the employer and also of the piece worker will be increased, and the worry of the honest day worker by the change from unfavorable to favorable conditions greatly lessened.

For ordinary work in the railway smithshop the tweer should be at least 10 inches below the top of the forge. With this depth to the tweer and the fire prepared with fine wet slack well tamped around a stake, the fire will, with possibly the throwing out now and then of a small clinker, last from 7 o'clock until noon, and the slag and clinkers do not drop and clog as they will with less depth. We also have a body of fuel below the iron sufficient to produce and continue to produce the necessary heat and lessen the demand for a new fire in the middle of each half day.

This shop should have wrought iron, steel-faced anvils weighing from 300 to 400 pounds each, placed on portable gray iron stands, so that the smith may be able to adapt his position to the work. Each forge should of course have a full equipment of tools. Fifty cents expended in the proper tool will in the hands of a competent workman earn dollars for the employer.

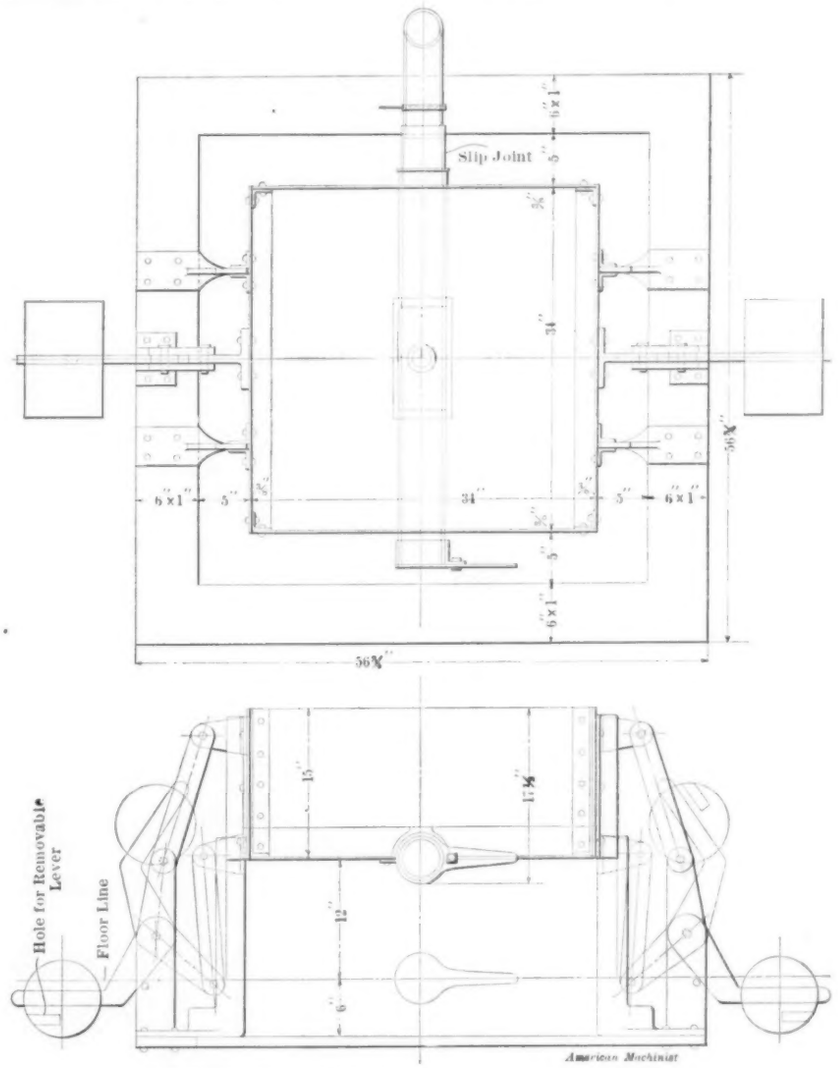
If the accumulation of good wrought-iron scrap is sufficient to employ the reverberatory furnace a greater part of the time its use, from a money-saving standpoint, is

*Abstract of a paper read by A. W. McCarlin before the National R. R. Master Blacksmiths' Association.

absolutely necessary, and in many localities where refined hammered iron of large dimensions cannot be got on short notice its services are required aside from its money-making qualities.

The demands for furnaces in the smith shop are many and pressing, as each day calls for a greater output at a reduced cost. We should have special furnaces for special classes of work as follows: the large reverberatory furnace and the billet furnace, which may be of similar design, which will also be useful in heating material for small forgings. These furnaces also answer nicely for heating work to be formed on the machines. Then come the case-hardening and spring furnaces, and special furnaces for the heading and bolt machines, flue welding furnace, etc. Some of these special furnaces for special classes of work will increase the output over that of the forge from 300 to 400 per cent., as far as heating advantages go, but this would be profitless were it not accompanied by an equal shaping capacity of proper machines. An enumeration of the possibilities of the steam hammer in forging, bending, upsetting, riveting, shearing, coiling and uncoiling would furnish matter for a volume. It is a universal tool, and few railroad smith shops have more than 50 per cent. of the steam hammers that they should have. A deficiency prevents the use of special dies for the different classes of work. This applies to the drop hammer and all power hammers as well as to the steam hammer.

Any old steam hammer with special dies producing duplicate forgings will show a saving of $10 and up each day over the same class of work produced by hand, and if a 1,200-pound steam hammer can be installed for $1,500, the interest on the investment would, at 4 per cent., amount to $60 per year, or about the earnings of the hammer over hand work for one week, so that if kept in constant service it would mean a saving or gain of about $3,000 a year, and if operated only an hour a day it would still be a profitable investment. The loss each year of from $3,000 to $5,000 thru the need of a proper tool should surely not only recommend it, but procure it. The installation of steam hammers to-day calls for greater consideration than it did a few years ago. The adoption by many of our railroads recently of steel for many heavy parts of their engines calls for heavier hammers, larger piston rods, better kept dies and more secure foundations.



M'CASLIN DROP FORGE FOR WELDING LOCOMOTIVE FRAMES.

The number of cranes in the shop should be ample for all requirements, and when possible they should be placed so as to interchange without interfering with each other. They should be allowed a large factor of safety over the load intended for them and should have ball or roller bearings above and below. The pulley over which the reel chain runs in framework also should have roller bearings.

The next tool needed is the bulldozer, the machine that understands more languages than any other known piece of mechanism. Furnished with the proper tools this machine will compare well with the steam hammer in its money-earning capacity. The up-to-date smith shop of to-day, if of sufficient size, has steam hammers, bulldozers, heading machines, forging machines, bolt machines, punch and shears, etc., and the foreman should remember that they were bought for a purpose and should find profitable employment for them all.

There have been several ideal smith shops erected by our railroads in the last few years and many others are in contemplation. Railroad companies that have built these shops have been lavish in the expenditure of money in the interest and comfort of the employee, and by the installation of improved machinery and appliances such as mentioned in this paper much of the work formerly done by hard manual labor is now accomplished with little effort, and while the output is increased, the demand for the man is not decreased; and being thus relieved of the most laborious part, should he not feel like increasing his speed just a little?

Ventilation and light in the smith shop are being considered as never before, the lavatory and many of the conveniences of the hotel have been added, thus inviting tidiness and affording the opportunity for the mechanic to elevate himself and his calling.

Ideal shops must be the product of ideal employers, and the natural sequence should be ideal employees. The component parts of the ideal foreman should be brains, common sense, experience, and then he should have a large bunch of privileges.

"One of the large driving belts at the Royal Mills, Pawtucket, R. I., which was sent to Providence last week to be taken up, when put on Monday, proved to be so loose that it had to be taken off again and returned to Providence. The mill was stopped in consequence." This "news" item indicates that Providence is not a good place to which to send belts to be "taken up" and that they should not be taken down to Providence to be taken up.

Design of a 4,000-Ton Hydraulic Press—II.

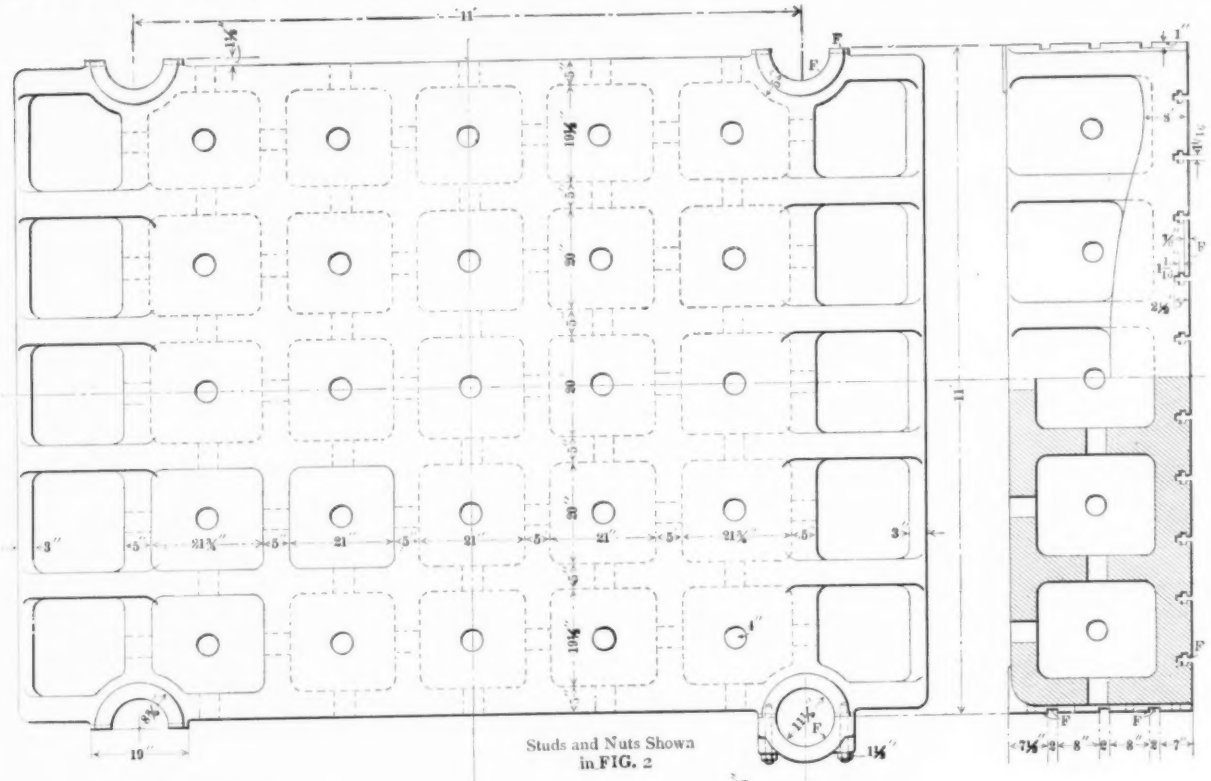
BY W. E. MOREY.

In designing the top platen, Fig. 5, it may be considered either as a beam with two end supports and with a single load in the center or as a beam with two end loads and two intermediate supports.

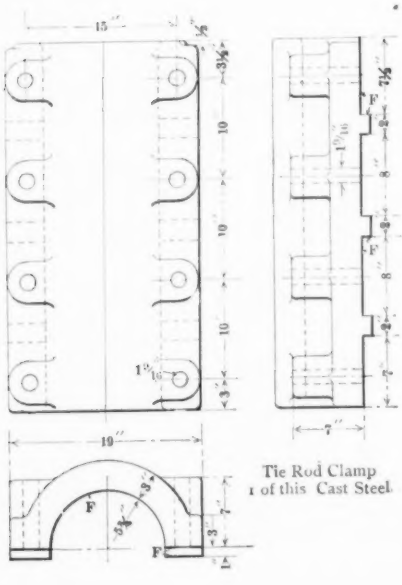
The centers of the rods are 11 feet apart each way, in order to give the desired clear space of 10 feet between them, while in one direction the platen measures 15 feet over all.

As any case where the loads are uniformly distributed would be more favorable to the casting, we will confine ourselves to the cases of concentrated loads with a view to determining the greatest bending moment.

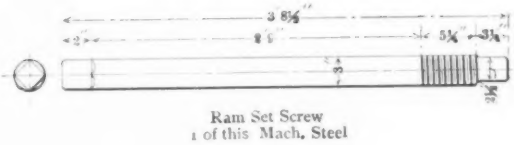
By formula 11, considering two end supports and a single central load equal to the greatest pressure available, we find the



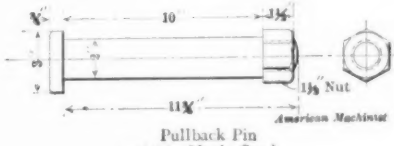
Upper Platen
1 of this Cast Steel



Tie Rod Clamp
1 of this Cast Steel



Ram Set Screw
1 of this Mach. Steel



Pullback Pin
1 of this Mach. Steel

FIG. 5. DETAILS OF PRESS.

maximum bending moment to be in the center of the span and equal to 270,468,000 inch-pounds, diminishing to zero at supports, as shown by the moment diagram Fig. 6.

By formula 12, considering two end loads and two intermediate supports, we find the bending moment to be constant between supports and equal to 98,352,000 inch-pounds, diminishing to zero at ends, as shown by the moment diagram Fig. 7.

Taking the greatest of these, the section modulus necessary to keep the fiber stress down to 16,000 pounds per square inch is found by formula 13 to be 16,904.

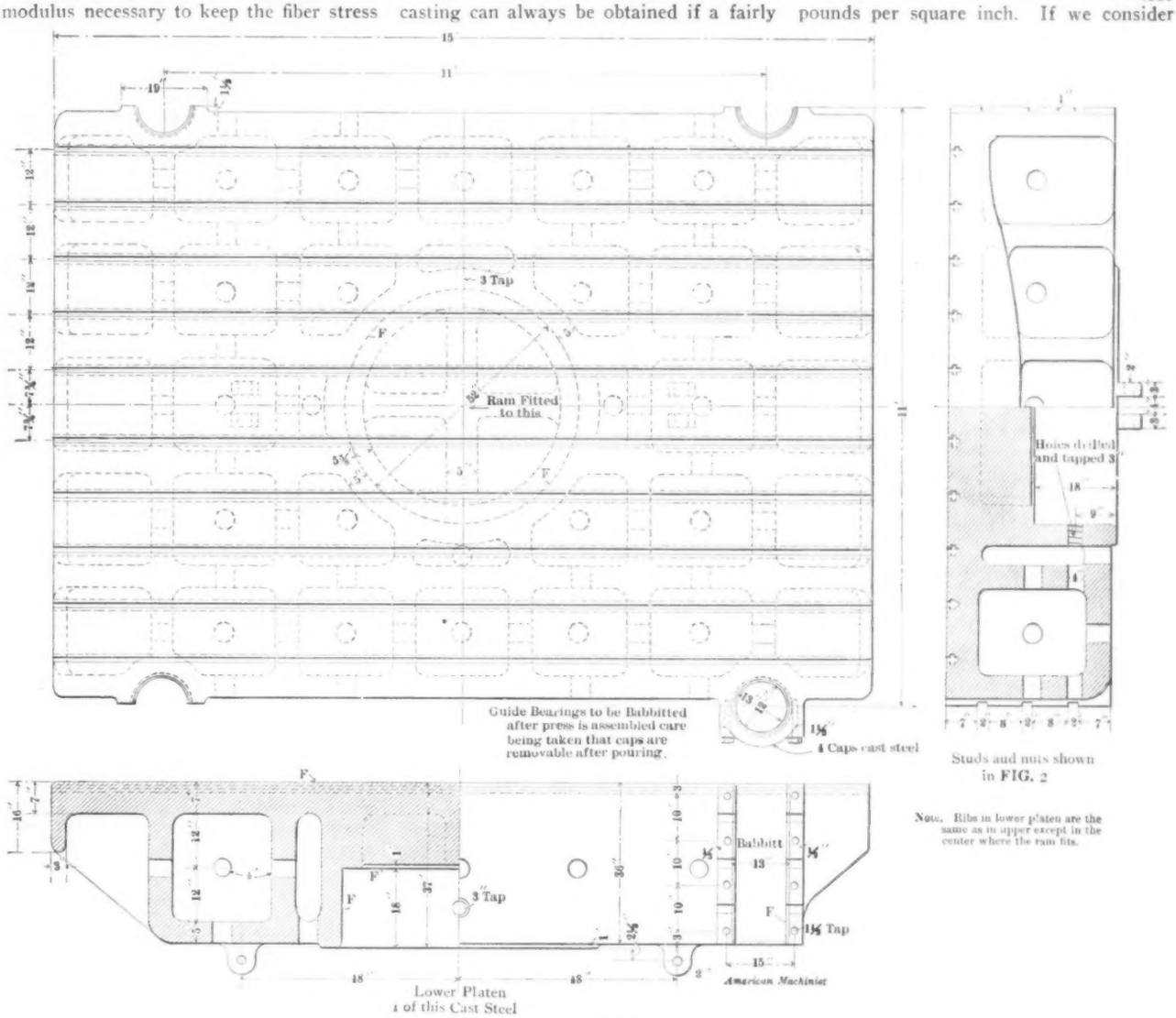
From a strictly theoretical standpoint, it would be correct to design the girder with a varying depth from center to ends, but the difficulties of making and setting the cores for such a design make it preferable to make the casting of the greatest strength necessary in the center and to continue this section to the tie rods and then slope to the ends.

It will be observed in Fig. 5 that there are a number of cores employed in making the casting which are similar in all respects and, considering the fact that one press only is to be built from these patterns, it is thought that the excess of metal used is more than offset by the work saved in both pattern shop and foundry. To obtain by algebraic computation the dimensions which will give the desired section modulus, 16,904, would involve such long and complicated calculations that we will again resort to the method of assuming premises and observing the results of same. As a practical consideration, we must bear in mind that a better casting can always be obtained if a fairly uniform section is adopted, and to this end we will assume a thickness of 5 inches and make our castings of this even thickness throughout except the lower portion where we are obliged to increase the thickness to 7 inches on account of the numerous bolt slots in lower face. In passing, it may be remarked, it is found best to plane these slots rather than to core them, as it insures free movement of bolt heads from end to end.

Our casting as assumed is 36 inches in depth with a 5-inch top member and a 7-inch lower member, the two being connected by six 5-inch webs, with the necessary openings for core connections, the whole reducing to the simple equivalent form shown in Fig. 8.

By the method of moments as employed in formula 14, the center of gravity or neutral axis is found to be 14 inches from the lower surface, and by dividing it into convenient sections, we find, by formula 15, that the moment of inertia is 309,157, giving a section modulus of 16,359.

Employing this last in formula 17, we find the maximum fiber stress to be 16,535 pounds per square inch. If we consider


3 Tap
Ram Fitted to this
Guide Bearings to be Babbitted after press is assembled care being taken that caps are removable after pouring.
4 Caps cast steel
Holes drilled and tapped 3
Studs and nuts shown in FIG. 2
Babbitt
3 Tap
1½ Tap
Lower Platen
4 of this Cast Steel
American Machinist

Note. Ribs in lower platen are the same as in upper except in the center where the ram fits.

FIG. 5. DETAILS OF PRESS.

as a beam the platen in a direction at right angles to that in the last case, we shall find a higher section modulus and a correspondingly lower fiber stress. In any case, the result gives us a factor of safety of practically 4.

The lower or moving platen is designed along the same lines, differing only in that the ram is fixed in the lower side. The ram bears against the bottom of platen with a total area of 1,458 square inches, which gives a unit crushing load of 5,621 pounds per square inch. The attachment of the ram to the platen is effected by the use of two 3-inch rods threaded as shown

in Fig. 5 and turned down to a diameter of 2½ inches at the ends. The inner wall of the platen is drilled and tapped and cored holes permit these rods to be passed thru ribs of platen and screwed into the inner wall until turned ends enter the wall of the ram. The shearing area of these two pins is ample for the pull-back of 100 tons, and their location at points in line with the least dimension of the platen permits a slight rocking in the direction in which it is most likely to occur and which is due to unequal distribution of the load. It is apparent that this rocking will increase somewhat as the press is used and the parts work loose.

The bearings for the guides are designed to be babbitted after the press is assembled, and care must be taken that the babbitt in the caps is separate from that in the large casting. These caps are keyed exactly as are those for the upper platen, and in fact the same platen may be used if desired, tho it will be necessary to recess the same with the boring tool to hold the babbitt. In all the tie-rod openings plenty of stock must be allowed for finishing, as the shrinkage of large castings cannot always be calculated to a nicety, and it will be found advisable to bore out even those holes which are later to be babbitted.

The design of a cylinder to resist rupture by external pressure requires that we take into account so many things whose influence cannot be correctly calculated that their design has been largely the result of experiment and various authorities give different empirical formulas for the solution. In designing the main ram, we may consider that the ends lend a large amount of support to the sides, and for this reason may feel safe in assuming that the ram would fail by direct crushing alone, taking no account of variation of stresses due to deformation of the circle, or to varying distance of the layers from the center. The necessary thickness of walls is found by formula 18 to be 5⅝

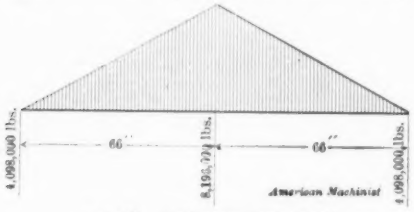


FIG. 6. MOMENT DIAGRAM.

inches, and by making the radius of the lower head equal to the diameter of the ram the same stress is obtained in head with an equal thickness of metal. The upper end of the ram, it will be noted, is reenforced by two ribs at right angles.

The choice of packing to be used for the ram is largely a matter of opinion, but a braided flax packing about 1½ inches square, well filled with paraffine, will be found to be practically leakage proof, it being only necessary to screw down the gland occasionally to maintain an almost perfect joint. The large diameter of the ram precludes the use of the empirical rule often employed of making the length of packing equal to the diameter of the ram; but, considering the slow movement of the parts and the fact that there is no heat to increase the wear, it is found that in hydraulic press work a length of packing of from ⅛ to 1/6 of diameter of ram is sufficient, which gives in this case a length of 8 inches. The

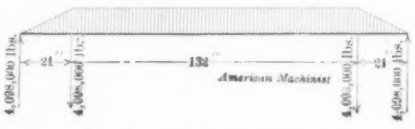


FIG. 7. MOMENT DIAGRAM.

calculation of the studs necessary to compress this packing is based on the assumption that they should be sufficient in number to safely resist the total pressure possible on the lower surface of the gland, which pressure is by formula 19 found to be 870,000 pounds. Again, the gland is of such large size that the nuts may very easily be unevenly screwed down, thus providing greater stresses in some studs than in others, and therefore it is thought advisable to limit the working stress to 10,000 pounds per square inch, which makes necessary a total stud area of 87 square inches. Now the size of ram determines that the diameter of the stud circle shall be 69 inches with a circumference of 216¾ inches, which allows room without crowding for 36 studs, the area of each at the root of the thread being 1-36 of 87 square inches, or 2.4 square inches, and from tables we find that the stud having its area nearest to this is 2 inches in diameter. The flange of the gland we will make 2¼ inches in thickness, as it must be stiff enough to support the immense stress of over 400 tons with safety.

The pull-backs consist of piston heads fitted with cup packing, and piston rods by which the pull is transmitted to the lower platen. The least diameter of the piston rod to sustain the load of 100,000 pounds is 2.8 inches, as shown by formula 20, and by making the rod 3¼ inches in diameter and threading the lower end to 3 inches we have sufficient strength for the load and also have a shoulder of ⅛ inch, against which we can draw up the two parts of the piston head and thus securely clamp the cup leather between their grooved surfaces. This cup is made of 3-16 inch sole leather, which is formed wet and allowed to dry in the mold. The diameter of head necessary to give the required tension on the rod is found by formula 21 to be 7¼ inches. Each cylinder is bushed with a copper pipe, to insure a smooth surface which will not be pitted by corrosion in service.

At the top of each pull-back cylinder may be seen a casting fitting the piston rod and acting as a packing chamber. The advantage of this will be apparent as permitting the boring of the main cylinder and the two pull-back cylinders without inverting the casting, which would not be the case if the small cylinders were closed on top. The use of this packing chamber, however, throws the entire load of pull-back on the studs which hold down the packing gland, and we are obliged to use much heavier studs than would otherwise be necessary. The effective pressure on the bottom of the chamber being 177,000 pounds, we must have ten 1⅜-inch studs, which gives us a fiber stress of 16,740 pounds per square inch.

These packing chambers are secured against leakage by lead gaskets which are placed underneath the castings and firmly held between grooved surfaces.

The attachments of the pull rods or piston rods to the platen are in the nature of universal joints as shown in Fig. 1, consisting of 2-inch pins passing thru lugs on lower side of platen and also thru eyes on end of pull rods, which eyes are made with a rounded bearing on pins. The pull-back pressure pipes are connected at the sides of the casting, as shown in Fig. 1 and detailed in Fig. 2.

The pipe used is 2-inch double extra strong, attached by means of threaded flanges which are screwed on the ends of the pipe for some distance while the projecting of pipe is held in counterbore by four ⅞-inch studs. A lead gasket is placed in each counterbore against which the pipe is clamped, insuring a tight joint.

Regarding valves for operating the press, nothing will be said except that they are designed so that pressure from the 300-pound main is used to bring the dies into working position, and then when the resistance of the work is so great that the full 300 pounds pressure is attained in the cylinder the 1,000 pounds pressure is automatically admitted. This effects a great saving in cost of operation, as the greater part of the stroke does very little work. In cases where 3,000 pounds pressure is desired, the operator opens another valve connecting with the high-pressure main. automatic checks preventing the water from backing up into the other valves and

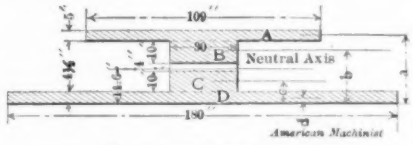


FIG. 8. EQUIVALENT SECTION.

doing them injury. The water, after passing thru the operating valves, enters the cylinder thru a 7-inch double extra strong pipe 7⅝ inches in diameter outside and 5⅞ inches in diameter inside, which is secured to the cylinder in the same manner as are the pull-back inlets and held in place by ten 1½-inch studs. In the design of valves special care should be taken to secure a free exhaust, as it permits of a rapid return stroke and increases the output of the press.

In operating the press it is desirable to

provide means of blocking up the lower platen whenever it is unnecessary to use the entire stroke, as it saves a large amount of water, all of which must be pumped up to accumulator pressure at so much per gallon.

The immense weight of the various castings requires that the foundations shall be of solid construction. In the assembled view of the press may be seen a section of the foundation showing a 15-inch I-beam riveted to a 12-inch channel, the whole being imbedded in a concrete wall composed of 1 part of Portland cement, 9 parts of crushed stone, 6 parts of sharp sand, 5 parts of gravel. The supporting walls are under but two sides of the press, but on the outer sides the walls are built up to the same hight, forming a pit, the floor of which is covered with a 3-inch layer of the same material and the whole cemented on the inside, making it water tight. This pit must be made of sufficient depth to give ready access to the pull-back pistons and main cylinder pipe connections. The depth of the supporting walls and the breadth of the footings is a matter to be determined by the character of the soil where the press is installed.

In closing, we may take note of some points which may be of use in installing the press and which will assist in securing the maximum efficiency.

Of course a floor must be provided close up to the press on all sides, and in Fig. 1 it will be noted that 8-inch walls extend above the press foundation to support the floor timbers. A trap door is required with a short ladder leading down into the pit, and also some means of pumping out the water which will accumulate in the course of time from the leakage of the press and pull-back cylinders, unless the pit is so situated that it can be drained.

It is also recommended that a track be laid up to the press, on two sides at least, to facilitate the handling of dies and material, and if possible it should be located where it may be served by a traveling crane. If this is not convenient, however, jib cranes or trolleys should be provided with air hoists or chain blocks, so as to conveniently reach all sides of the press.

FORMULAS.

11. $M = \frac{L \times l}{4}$

M = bending moment at center of platen in inch-pounds.

L = total load of press in pounds = 8,196,000.

l = distance between tie rods in inches = 132.

$M = \frac{8,196,000 \times 132}{4} = 270,468,000$ inch-pounds.

12. $M = \frac{L \times l_1}{2}$

M = maximum bending moment.

l_1 = length of overhang in inches = 24.

L = total load of press in pounds = 8,196,000.

$M = \frac{8,196,000 \times 24}{2} = 98,352,000$ inch-pounds.

13. $\frac{I}{e}$ = section modulus = $\frac{M}{f}$

I = moment of inertia of section of platen.

M = maximum bending moment = 270,468,000 inch-pounds.

e = distance of outer fiber from neutral axis.

f = working stress of metal or 16,000 pounds per square inch.

$\frac{I}{e} = \frac{270,468,000}{16,000} = 16,904.$

14. $X = \frac{Aa + Bb + Cc + Dd}{A + B + C + D}$

X = distance of neutral axis from base in inches.

A = area of top flange in sq. inches.

B = area of 2d section " "

C = area of 3d section " "

D = area of lower flange " "

a, b, c, d = distances of respective centers of sections from base in inches.

$X = \frac{(545 \times 31) + (300 \times 23.5) + (300 \times 9.5) + (810 \times 2.25)}{545 + 300 + 300 + 810} = 14.6$ inches

15. $I = Ia + Ib + Ic + Id$ = total moment of inertia of section.

$Ia = (\frac{1}{12} \times 109 \times 5^3) + (109 \times 5 \times 16.4^2) \ldots = 147,718$

$Ib = (\frac{1}{12} \times 30 \times 10^3) + (30 \times 10 \times 8.9^2) \ldots = 26,263$

$Ic = (\frac{1}{12} \times 30 \times 10^3) + (30 \times 10 \times 5.1^2) \ldots = 10,303$

$Id = (\frac{1}{12} \times 180 \times 4.5^3) + (4.5 \times 180 \times 12.35^2) \ldots = 124,906$

309,190

16. $\frac{I}{e} = \frac{309,157}{18.9} = 16,359.$

17. $f = M \times \frac{e}{I}$

f = working stress of metal in pounds per square inch.

M = maximum bending movement = 270,464,000 inch-pounds.

e = distance of outer fiber from neutral axis = 18.9 inches.

I = moment of inertia of section = 309,157.

$f = \frac{270,468,000 \times 18.9}{309,190} = 16,533$ pounds per sq. inch.

18. $t = \frac{p \times D}{2 \times f}$

t = thickness of walls of ram in inches.

p = pressure on ram in pounds per square inch = 3000.

D = diameter of ram in inches = 60.

f = working stress of metal in pounds per square inch = 16,000.

$t = \frac{3000 \times 60}{32,000} = 5\frac{5}{8}$ inches.

19. $P = \frac{(d^2 - d_1^2) \times \pi \times p}{4}$

P = total pressure on lower face of gland.

d = outer diam. of gland in inches = 63

d_1 = inner " " " = 60

p = pressure in cylinder in pounds per square inch = 3000.

$P = (3969 - 3600) \times .7854 \times 3000 =$ 869,437 pounds or practically 870,000 pounds.

20. $D = \sqrt{\frac{P}{\frac{\pi}{4} \times p}}$

D = diam. of pull-back rod in inches.

P = total pressure to be exerted by pull-back in pounds = 100,000.

p = working stress of metal in pounds per square inch = 16,000.

$D = \sqrt{\frac{100,000}{7854 \times 16,000}} = \sqrt{7.95} = 2.8.$

21. $D = \sqrt{\left(P + d_1^2 \times \frac{\pi}{4} \times p\right) \frac{4}{\pi \times p}}$

D = diameter of pull-back piston in inches.

P = total pressure to be exerted by pull-back in pounds = 100,000.

p = pressure in cylinder in pounds per square inch = 3000.

d = diameter of piston rod in inches = 3.25.

$D = \sqrt{[100,000 + (10.56 \times .7854 \times 3000)] \frac{4}{.7854 \times 3000}}$

$\sqrt{53} = 7.28$ inches.

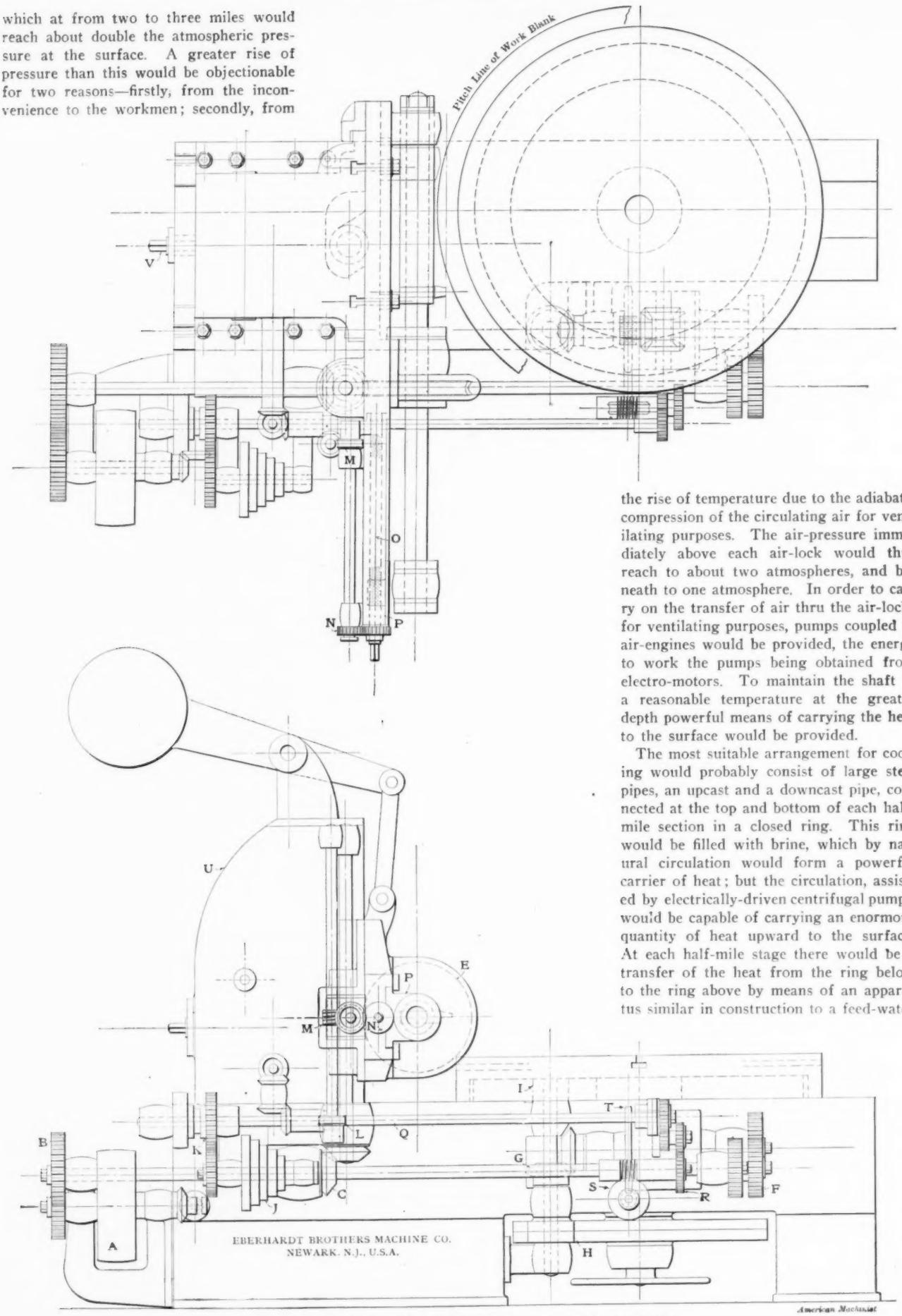
To Sink a Shaft Twelve Miles Deep.

In an address by the Hon. Charles Parsons before the British Association for the Advancement of Science the speaker, after calling attention to the possible enormous discoveries or additions to our practical knowledge which might result, proceeded to consider the method and the means, the difficulties in sight to be encountered and the probable cost of such an undertaking. It involves, as will be seen, a number of problems not usually thought of in connection with such a scheme, and their thoughtful and careful setting forth will be found highly interesting. The mere cutting of the rock and the hoisting of the material to the surface here become secondary considerations, and the control of air pressures and temperatures takes the first place. The following is taken from the address referred to:

The exact position of such shaft would require some consideration as to whether it should commence in the primary or secondary strata. It would be sunk in stages, each of about half a mile in depth, and at each stage there would be placed the hauling and other machinery, to be worked electrically, for dealing with each stage. The depth of each stage would be restricted to half a mile in order to avoid a disproportionate cost in the hauling machinery and the weight of rope, as well as increased cost in the cooling arrangements arising from excessive hydraulic pressures. At each second or third mile in depth there would be air-locks to prevent the air pressure from becoming excessive owing to the weight of the superincumbent air.

which at from two to three miles would reach about double the atmospheric pressure at the surface. A greater rise of pressure than this would be objectionable for two reasons—firstly, from the inconvenience to the workmen; secondly, from the rise of temperature due to the adiabatic compression of the circulating air for ventilating purposes. The air-pressure immediately above each air-lock would thus reach to about two atmospheres, and beneath to one atmosphere. In order to carry on the transfer of air thru the air-locks for ventilating purposes, pumps coupled to air-engines would be provided, the energy to work the pumps being obtained from electro-motors. To maintain the shaft at a reasonable temperature at the greater depth powerful means of carrying the heat to the surface would be provided.

The most suitable arrangement for cooling would probably consist of large steel pipes, an upcast and a downcast pipe, connected at the top and bottom of each half-mile section in a closed ring. This ring would be filled with brine, which by natural circulation would form a powerful carrier of heat; but the circulation, assisted by electrically-driven centrifugal pumps, would be capable of carrying an enormous quantity of heat upward to the surface. At each half-mile stage there would be a transfer of the heat from the ring below to the ring above by means of an apparatus similar in construction to a feed-water



A NEW GEAR CUTTING AND WORM-WHEEL GENERATING MACHINE.

heater, or to a regenerator constructed of small steel tubes, thru which the brine in the ring above would circulate, and around the outside the brine in the ring below could also circulate, the heat being transmitted thru the metal of the tubes from brine ring to brine ring.

We have now presented to us two alternative arrangements for cooling. One arrangement would be to cool the brine to a very low temperature in the top ring at the mouth of the shaft by refrigerating machinery, so as to provide a sufficient gradation of temperature in the whole brine system, to insure the necessary flow of heat upward from brine ring to brine ring, and overcome all the resistances of heat transfer, and so maintain the lowest ring at the temperature necessary for effectual cooling of the lowest section of the shaft. But a better arrangement would be to place powerful refrigerating machinery at certain of the lower stages, the function of this machinery being to extract heat from the ring below and deliver it to the ring above. This latter method would increase to a very great extent the heat-carrying power of the system, which in the first arrangement is limited by the freezing temperature of brine in the descending column and the highest temperature admissible in the ascending brine column. The amount of heat conducted inward thru the rock wall and requiring to be absorbed and transferred to the surface depends on the temperature and conductibility of the strata. But there is no doubt that the methods I have indicated would be capable of maintaining a moderate temperature in the shaft to depths of twelve miles.

During the process of sinking at the greater depths the shaft bottom would require the application of a special cooling process in advance of the sinkers, similar to the Belgian freezing system of M. Poesche used for sinking thru water-bearing strata and quicksands, and now in general use. It consists in driving a number of bore-holes in a circle outside the perimeter of the shaft to be sunk; thru these bore-holes very cold brine is circulated, thus freezing the rocks and quicksands and the water therein, and when this process is completed the sinking of the shaft is easily accomplished. In our case this process would be maintained not only on the shaft bottom, but also for some time on the newly-pierced shaft sides, until the surrounding rock had been cooled for some distance from the face.

Depth from the Surface.	Cost.	Time in Years.	Temperature of Rock.
For 2 miles	£ 500,000	10	122° F.
For 4 "	1,100,000	25	152° F.
For 6 "	1,800,000	40	182° F.
For 8 "	2,700,000	55	212° F.
For 10 "	3,700,000	70	242° F.
For 12 "	5,000,000	85	272° F.

As to the cost, rate of boring, and normal temperature of the rock, an approximate estimate has been made, based on the experience gained on the Rand, but including the extra costs for air-locks and cooling. This is embodied in the table here given.

A New Gear Cutting and Worm Wheel Generating Machine.

The line drawings show a front elevation and top view of a new type of gear-cutting machine made by Eberhardt Brothers Machine Company, of Newark, N. J., which, as shown, is specially arranged for generating the teeth of worm wheels with or without the use of hobs. Machines have been made in Europe, and one at the works of Hugo Bilgram, in which worm wheels could be cut in a similar manner, but this machine contains several improvements which greatly increase the rigidity of the parts under the cutting strains.

The scheme of the machine and the process are as follows: The cutter used in place of a hob is, as shown, a fly tool, ground, after hardening, to the standard thread angle of 14½ degrees, or, with wheels of few teeth and to avoid undercutting, 20 degrees may be used. The cutter is set out the proper distance—*i. e.*, half the worm outside diameter plus the clearance, and is swiveled to suit the worm thread angle by a suitable gage which accompanies the machine. Single, double, triple or any multiple thread can be accommodated, and right- or left-hand threads may be cut by swiveling the tool in the proper direction. The cutter spindle is set to the correct center distance by means of a vernier scale on the bed and stanchion. The tool starts at one side of the blank and travels sidewise across its face, the blank meanwhile revolving at the proper speed.

For commercial gears, one pass across of the tool finishes the job, but better results are obtained by taking a finishing cut. The process of cutting is by no means a weak, nibbling one; on the contrary, the chips that roll out from this tool are comparable with those made on a good, stiff planer.

The cutter drive and dividing train are driven by the pulley *A*, the cutter speeds being varied by the change gears *B*. The power then goes to the tool thru the bevels *C* and worm drive *E*. The main horizontal shaft continues to the dividing change gear nest *F*, whence the motion passes thru the "jack box" and gears *G* and *H* to the work spindle. For heavy wheels of large diameter the work is driven by the face-plate gears *I*, thus doing away with all torsion of the work spindle. For small diameters the lower gears *H* are used.

In worm wheel and spiral gear cutting the dividing gears are constantly revolving, and hence their accuracy is just as important as that of the master wheel. These change gears are cut very accurately by a special process.

The feed drive and compensating or conjugating trains are driven from the cone pulley *J*, thence thru change gears *K* to worm drives *L* and *M*, to spur gears *N*, to feed screw *O*, which moves slide *P* and cutter spindle sidewise. While the tool is moving sidewise the blank must move a proper amount on the pitch line, and this is accomplished thru the following train: The horizontal feed drive shaft *Q* continues to the change gear nest *R*, thence to worm drives *S* and *T*, thus moving the jack box a plus or minus amount and so affecting the rotation of the blank.

It will be observed that the worm drive *T* is upon the exterior of the jack box cage, which is thus rotated bodily by the conjugating train *R*, whereas the index train *F* connects with the right-hand gear of the jack box train, the final effect upon the left-hand gear of the jack box train and upon the work being thus compounded from the conjugating and indexing trains.

The jack box or differential gear nest has been used in Europe for a similar purpose and is a very ingenious and satisfactory mechanism for giving the effect of two distinct and independent motions to the work. To better illustrate its action let us suppose the dividing gears *F* to be removed, and the conjugating change gears *R* only in action. With a blank in place and the cutter revolving under these conditions, the circumferential movement of the work blank at the pitch line would be the same as the horizontal movement of the cutter and only one groove or space would be cut in the blank, and it would be parallel with the blank axis. The tool would sweep up or generate a mating curve as it moved sidewise in unison with the work.

Now suppose the gears *R* to be removed and the dividing gears *F* only in action. Were the cutter to revolve and feed sidewise under these conditions, only one groove would be cut and it would be a rather useless one; in fact, the blank would then resemble a grooved pulley, as the tool would gradually cut all the teeth out and only leave its circular path behind. However, in this case, if we lock the tool slide *P* so that it cannot move sidewise, put an ordinary cylindrical hob on the cutter bar and feed the hob into the blank by moving the stanchion *U* forward, with screw *V*, a worm-wheel would be hobbed as in the usual manner.

Combining the above two gear trains by means of the jack box produces the desired effect in worm-wheel generating—that of dividing while conjugating.

In the older types of machines operating on the fly-tool or taper hob principle, the side movement of the cutter was given by means of a slide directly under the cutter bar, which necessitated bringing the cutter further out and thus gave several inches extra overhang, with the accompanying loss of rigidity. On this machine the tool slide is at one side, allowing the cutter spindle to be brought very close to the main bearing. This also allows the cutter spindle bearings to be adjusted close up to

the blank, and thus shortening the bridge required in the older constructions in which the bearings are carried along with the slide.

This machine is also made to cut spur gears with the usual rotary cutter, and, with an extra swivel slide, can cut spiral and spur gears entirely automatic by means of a hob. This method of using a hob has several important advantages, chief of which is that one hob cuts all gears of a given pitch. The tooth curve is generated in each gear; in other words, one cutter is correct for all numbers of teeth. No time is lost after the machine is started, as the hob commences to cut and keeps cutting without stopping to return or divide. One advance of the hob across the face of the work finishes the gear.

These machines are made in two styles, plain and universal, and in six sizes for each style. In the plain machine worm-wheels are cut in which the worm is at right angles to the axis of the wheel. This style of machine also cuts spur gears with the usual rotary cutter. In the universal machine worm-wheels can be cut to suit worms at any angle to the axis. This style machine also cuts spiral and spur gears either with the ordinary rotary cutter or with a hob. Either style machine can use taper hobs, in which case the hob enters the blank like a tap.

When cutting worm-wheels for single thread worms, using a fly tool, the cutting is always continuous from start to finish, but, when cutting wheels for multiple-thread worms, this is not always true. For example, when cutting a wheel with an even number of teeth for a worm of two threads the first action is to cut one-half the tooth spaces—that is, those which mesh with one of the worm threads represented by the single fly cutter. These teeth finished, it is then necessary to hand index the blank for the remaining set of spaces. If, however, the wheel has an uneven number of teeth, the action is continuous as when cutting a wheel for a single thread worm, and this action may often be brought about by adding a hunting tooth to the worm-wheel. For example, in cutting a worm-wheel of 20 teeth, in which the ratio of wheel to worm is 1 to 1 (a ratio which this machine can easily cut) the wheel would have to be indexed 19 times; whereas, if the wheel could have 21 teeth, to suit a worm of 20 threads, one setting of the fly-tool would cut the 21 teeth without any further indexing.

Blue smoke in the exhaust indicates an excess of lubricating oil in the auto cylinder, while black smoke indicates an excess of gasoline. Any smoke indicates a nuisance.

In 1903 there were but 15,249 miles of iron railroad track remaining in the United States, or only 5.4 per cent. of the total mileage of the steam railroads of the country. Old iron rails bring a higher price than old steel rails.

Letters From Practical Men.

Dimensions on Drawings.

Editor American Machinist:

The article at page 1359 by Frank B. Kleinhans reminds me of some points in dimensioning to which attention might frequently be called without harm. His Figs. 1 and 2 serve to illustrate the fact that we should know the use to which a piece is to be put before we can intelligently dimension it. For instance, in his Fig. 2—repeated in my Fig. 1—he gives dimension of A separately from B and adds up $B + C + D$ in one dimension. If this stud, as we may be justified in imagining, has part B driven into a frame or plate up to shoulder K and is secured by a nut on A so as to support moving or stationary parts on D, E and F secured by a nut on F, then the essential dimensions should read from shoulder K, as in my Fig. 2. Further, it may be that D is simply an unused portion of the stud carrying a bearing at E out away from the collar C, or it may carry a running part; in either case $D + C$ should be given and E dimensioned beyond that. Possibly E carries a part which must be forced on and clamped between the shoulder H and a nut or washer on F, in which case E is simply required to be a trifle shorter than the hub of the pieces forced on it, and it may be best to show that the thread on F should be cut up within a certain distance of shoulder H.

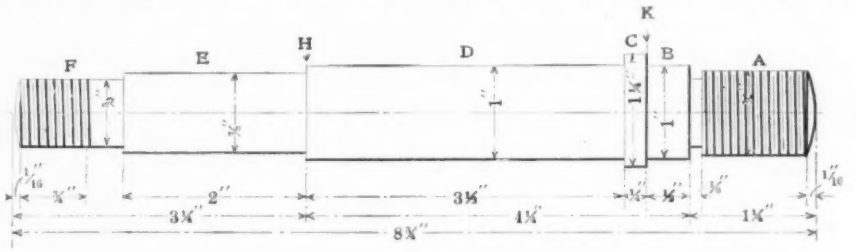
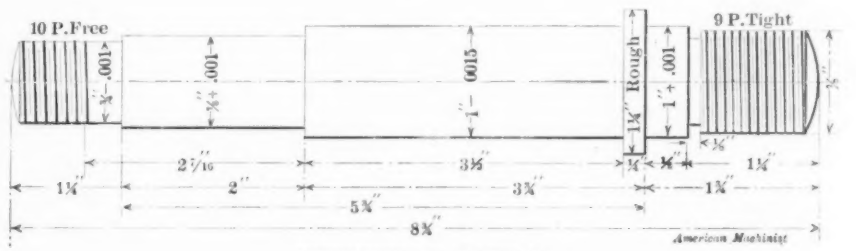


FIG. 1



DIMENSIONS ON DRAWINGS.

Then, too, as to diameters; how do we know what size to make any of these parts? In these days of micrometer calipers we would not be justified, if we followed the drawing, in making part B anything but 1 inch in diameter. Suppose that it is really required to be driven into the framework of a machine into holes already reamed standard. Suppose our Jones & Lamson hand should make up a thousand of these studs to drawing also standard. Also suppose that a variation of a quarter of a thousandth is allowed from standard either above or below; how large a percentage of these studs will have to be driven home?

If some part is to run on D and is also reamed standard and the stud is standard, too, our limit of one-quarter thousandth will allow a part of the work to turn if well oiled, but more of it will have to be refitted before it is used. Of course these remarks apply to other drawings than those shown by Mr. Kleinhans; in fact, for 99 per cent. of the detail drawings in use a guide book should be appended reading something like this: "This drawing will do to rough out by; when you are ready to finish, go downstairs to Jerry and get five or six apron plates and fit the short ends so they will all drive in the largest one. Go to Tom and get a few rockers that go on the other side of the collar and turn all the studs to run in the smallest one. Go upstairs to Dick and get a few of the pieces that go on the ⅞-inch part, fit them to force on easily. Get a ⅞-inch nut from the toolroom and make a wrench fit on the right-hand end, and get a ¾-inch nut and make a finger fit on the left-hand end; leave the outside of the collar rough."

Now, what better can we do? If we ask the draftsman what improvement he can suggest, he will blandly tell us that if he knew he wouldn't be drafting for a living.

So we have to ask ourselves. The first thing that we must have is a standard size hole within a limit set according to the accuracy demanded by our best work. Then it is no harder for the draftsman to find out once for all what sizes he really wants than it is for the individual workman to find out once. If he wants B .001 inch large he can say so; if D should be .0015 small he can give it—better 1 inch minus .0015 inch than .9985 inch. As for the collar, mark it "rough"; the threads marked "tight" and "free" tell the story. With this sketch in Fig. 2 the workman can go ahead and make the stud

with the aid of micrometer and a set of sample nuts, with the assurance that he is making what is wanted. If he is not especially provided with the latter, he will soon accumulate a set.

Now, there are lots of shop owners and superintendents who will say, "Why, we standardized everything long ago." True they bought some standard gages and tools, dropped them into the toolroom and never thought of them afterward, except the day they paid the bill; but in the majority of places work is still done on the old "cut and try" plan, perhaps not in all particulars, but in many of the most essential dimensions. Why? Partly because the men and the foremen know that the drawings brought to them do not tell the whole truth; partly because the drafting room doesn't dare to claim that they are complete, and partly out of habit.

It adds to the draftsman's responsibility to make his drawings complete, and if he guesses that about .005 or .010 inch is about right to allow for a drive fit on a 1-inch stud, he may hear something from it, but it will do him good. The methods gaining ground, of getting out drawings showing operations and instructing workmen as to speeds, feeds, etc., are helping this drawing question a great deal, but there remains a large amount of work, worth detailing but not worth getting out an operation sheet for, to which these remarks still apply. E. H. FISH.

Worcester Polytechnic Institute.

The Accident to the "St.Louis."

Editor American Machinist:

Dixie, at page 1374, exclaims: "Overstrain the bolt—never." This is equivalent to the shore sentiment, "You can't get that nut too tight." So far as I know, bolts and nuts are tightened by guess, both big and little, and usually a man breaks his weight in bolts before he becomes even a novice in "training." I have been guilty of causing several minor wrecks, before thinking that the subject was worth considering, and now wish to express the opinion that any bolt may be subjected to a ruinous strain in tightening its nut. I give a negative instance, from which we may draw positive conclusions.

During the seventies the 6-inch nut on the crosshead end of the piston rod of the blowing engine of the Phoenix Furnace, Youngstown, O., gave trouble by working loose. During a shutdown to reline the stack—say a two months' job—the engineer took the nut off, put a corroding liquid on the end of the rod, then screwed the nut on good and tight. In the early nineties it became necessary to take this nut off to get the piston out of the cylinder. It was soon discovered that more than ordinary persuasion was necessary to make it let go the rod. It was suggested to cut the nut off, but that would require a new one, so it was decided to roll a steel billet into a slab at the sheet mill, shear the ends and edges, and drill out a hexagon hole for the nut, then play on it with a dolly, all as shown in Fig. 1. Lighter forged wrenches had been used in the same way, but were too elastic to communicate the concentrated force of the dolly to the nut. As most of the thread in the nut stayed on the rod, it cannot be possible that previous pounding with the lighter wrenches loosened it at all. There is about the same difference in tightening nuts of this size that there would be between lighting on a feather bed and a concrete pavement from a window above. It is always best to have "a full nut" on a bolt, but three or four threads sustain the pull on the bolt, when properly loaded. I have pulled 2-inch bolts in two, just to see what would happen to the thread, which is represented in Fig. 2, as nearly as I can remember. The figure is not intended to be an exaggeration. Good iron will stretch one-fourth of its length, and often reduce its area considerably more, before parting, when subjected to initial and increasing stress. The same grade of iron, when subjected to repeated stresses, may break with half the load and show no more stretch or reduction than pig iron would. It will be seen in Fig. 2 that we have only about three threads to break down at a time. One generally concludes that the bolt is tight enough when at the bottom of the first thread below the nut it is permanently stretched, then repeated shocks crystallize the metal, and the bolt breaks at its leisure. It should not be forgotten that a pack of liners between the halves of the box, when tightened up in excess of that required to hold them in place, are elastic, and whatever that elastic force is, adds to the legitimate pull on the bolts.

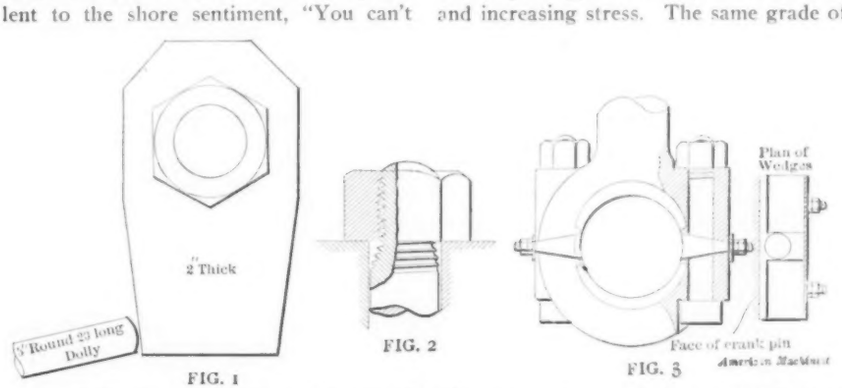


FIG. 1 FIG. 2 FIG. 3

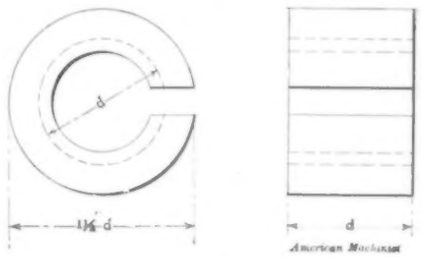
TAKING A NUT OFF. EFFECT OF STRETCH ON A BOLT. DESIGN FOR BOTTOM END.

It seems to me that the way that these afloat people do their work is awkward. In Fig. 3 I show a marine bottom end, the halves held apart with wedges, which also form an oil cup on each side of the pin, which may be of advantage, from a lubricating point of view. To adjust, slack the wedges an equal distance, tighten the main bolts as much as they require, then draw the wedges in with the screws and secure them with the jamb-nuts. AMOS PRICE.

Split Nuts For Use in Driving Threaded Work.

Editor American Machinist:

At pages 153 and 259 I came across descriptions of drivers and split nuts for threaded work. Using a nut which has a saw slit in one side can hardly be called good practise, especially if it refuses to come off easily. A cold chisel driven in the slot eases it, but after doing this a few times the result is the second stage in the evolution of the spilt nut, the halved nut. Now we have two pieces to put on our thread and introduce into the dog, which is troublesome, to say the least. Having a set of threaded carriers or one carrier with inserted tapped bushes seems to be overdoing the matter.



SPLIT NUT.

I think I have struck the happy medium in the spilt nuts shown in the sketch I submit. I have had a set of thirteen, ¼ to 1 inch, in constant service for several years, and I believe them to be the cheapest and at the same time most effective yet heard from.

They take up a space of only 1 inch by 8¼ inches, placed tandem, with the slots over a narrow upright strip of brass to hold them in place.

They are made of cast steel, tapped to a full thread and turned concentric with the threaded hole. The length $= d =$ the diameter of the tap, and the outside diameter of the nut $= 1\frac{1}{2} \times d$. After the slots were cut, I opened the nuts a trifle with a chisel, to insure their being turned on freely by the fingers after hardening. It takes but a jiffy to spin them on. They were hardened in oil and given a spring temper by burning off the oil.

A common lathe dog or a three- or four-jawed chuck closes them on to a thread with a grip like grim death.

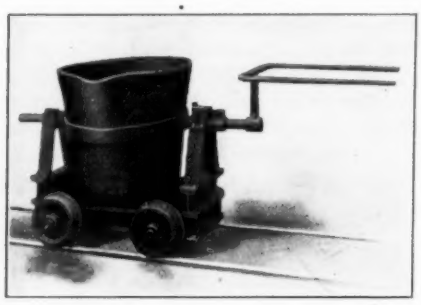
GEO. W. ARMSTRONG.

A Light Track Ladle.

Editor American Machinist:

A track around a machine shop is tolerably familiar, but we thought we were a bit smart when we laid a track also in the foundry where we handled a lot of small and middle-sized repetition work. This track of course was used for conveying castings and foundry impedimenta on ordinary trucks, but where we scored was in fixing the line of track right down the middle of the foundry and running half a dozen ladles, as shown in the half-tone, to feed the molders. The drawing shows three views of the ladle with the main dimensions given and is, I think, sufficiently clear without elaborate explanation. The frame is of channel iron and I-beams, the bearings being simple castings in gray iron; the wheels are 9 inches in diameter and chilled on the tread. The track gage was 18 inches, and one man could comfortably handle the affair. The ladle itself was of course, together with the chilled wheels, bought outside, but with these exceptions the whole thing was made by the millwright's department. Forging the large ring and riveting it to the ladle was the stiffest job. The other view on the sketch, to the smaller scale, shows the ladle run up to a three-ton cupola, ready for filling. The main point about the job is that it was done by a firm of toolmakers who had little or no smithing to do; and, as something entirely foreign to the ordinary product, I think it is worthy of note. C. V. R.

Cheshire, England.



A LIGHT TRACK LADLE.

Radial Stresses Due to Centrifugal Force in Revolving Bodies.

Editor American Machinist:

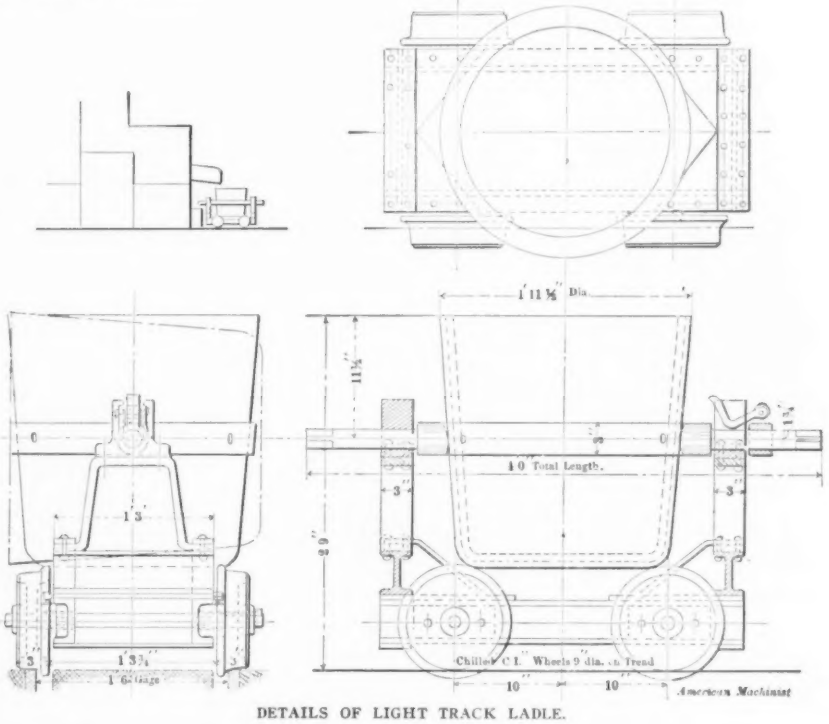
Being much interested in all problems relative to the design of steam turbines, I have carefully read the article by A. M. Levin, at page 1389, dealing with stresses due to centrifugal force in rotating bodies, but I cannot agree with his fundamental assumption nor with his conclusions.

First, I want to call the attention of the readers of your paper to the fact that the expression "radial stresses" gives a false idea of what we have to do with. In a rotating body the centifugal forces create both tangential and radial stresses, but in most practical cases the tangential stress is much in excess and the stresses Mr. Levin considers are all tangential.

The values he finds for the centrifugal forces are all right. It is also true that these centrifugal forces are balanced by stresses in the section *a—b* (Fig. 1 of his article), but Mr. Levin bases his further computations on the assumption that the stresses are evenly distributed over the section. That this is not the case was, as far as I know, first shown by Mr. Grübler in German papers, and lately Mr. Stodola has treated the subject in a most elegant manner in his book on steam turbines.

If the stresses are not evenly distributed their mean value must evidently be equal to the value found by Mr. Levin. This stress will occur at one particular radius of the section, in some places the actual stress will be smaller, in others it must be greater in order to give the mean stress mentioned. This consideration shows that the actual maximum stress is always more than what will be found by Mr. Levin's formulas.

In order to give an idea of the magnitude of the difference, I will give here the exact formulas for a disk of even thickness, which representing a special case may easily be derived from Mr. Stodola's general expressions. I will also give comparative results obtained by these and by Mr. Levin's formulas.



DETAILS OF LIGHT TRACK LADLE.

In a ring of even thickness, as shown in Fig. 1 of the article, the maximum stress will occur at the inner radius. Using Mr. Levin's notation, this stress will be:

$$S = 3\,\frac{\gamma}{g}\left[3 + \left(\frac{d}{D}\right)^2\right] V^2 \qquad (3a)$$

for d approaching zero, this becomes:

$$S = 9\,\frac{\gamma}{g}\,V^2 \qquad (6a)$$

i. e., more than twice the value found by Mr. Levin. For d approaching D, we have:

$$S = 12\,\frac{\gamma}{g}\,V^2 \qquad (7a)$$

the same as Mr. Levin's formula, because the radial width of the ring being infinitely small in this case, there is no chance for an uneven distribution of the stress.

Turning now to Mr. Levin's example No. 1 and inserting the quantities found there in formula (3a), we obtain:

$$S = 3 \times \frac{.28}{32.16}\left[3 + \left(\frac{3}{4}\right)^2\right] 790^2$$

$$= 0.0262 \times \frac{57}{16} \times 624{,}100 = 58{,}000 \text{ lbs.}$$

per square inch, where Mr. Levin has $S = 50{,}000$.

This difference is not so considerable, only on account of the relatively large bore d. For a smaller hole, the discrepancy is greater, as may be shown by applying the formula to example No. 3, question No. 3, for a disk of 8 feet diameter with a 1-foot hole. Mr. Levin's formula and table give a stress for this case of:

$$S = 4.56\,\frac{\gamma}{g}\,V^2$$

while Mr. Stodola's formula would give:

$$S = 3\,\frac{\gamma}{g}\left[3 + \left(\frac{1}{8}\right)^2\right] V^2$$

$$= 3 \times \frac{\gamma}{g} \times \frac{193}{64}\,V^2$$

$$= 9\,\frac{\gamma}{g}\,V^2$$

or a stress 97.5 per cent. greater.

For a solid disk without bore, Mr. Grübler shows in his deductions the maximum stress is only half that found by formula (6a), but even this would be 12.5 per cent. more than what Mr. Levin finds.

Mr. Grübler shows also, however, that a hole ever so small at the center of the disk would bring the stress up to the value of formula (6a).

In the other cases dealt with by Mr. Levin, the assumption of even distribution of the stress over the section produces similar errors. ROBERT CRAMER.

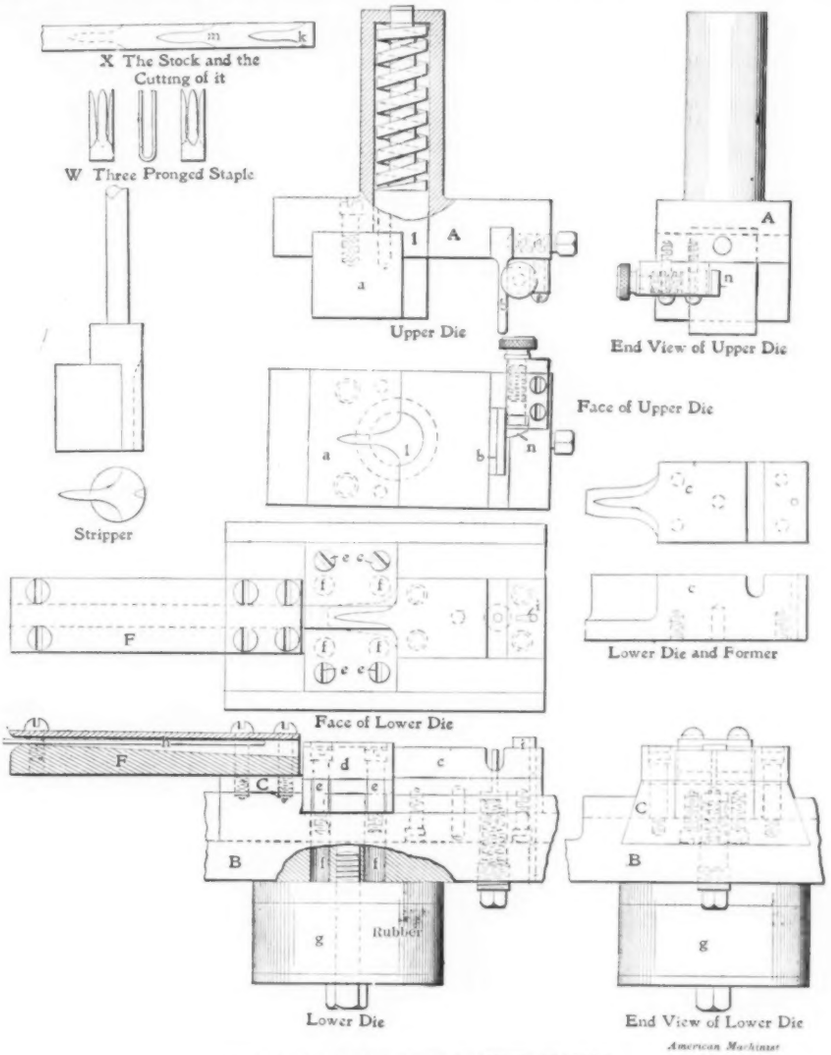
Milwaukee, Wis.

[There has been considerable discussion regarding the distribution of the stress thru the section, others beside Mr. Levin considering the stress to be uniform. Where doctors disagree we will not attempt to decide.—Ed.]

Automatic Die for a Three-Pronged Staple.

Editor American Machinist:

I send you a drawing of an automatic die for producing the three-pronged staple shown at *W*. A strip of the stock from which it is made is shown at *X*, the staples being made without any waste of material after the first end is cut off and the action of the machine being automatic and continuous until the strip of metal is used up.



AUTOMATIC DIE FOR THREE-PRONGED STAPLES.

The machinery steel punch-holder *A* is fitted to the ram of an open side, inclinable power press. The cutting is done by the upper cutting die *a*, and *b* is the forming punch, both made of tool steel and hardened. *B* is a gray-iron shoe fitted to the bed, and *C* is the machinery-steel die-holder dovetailed into the shoe *B*. *c* is the lower cutting and forming die, and *d* is a pad which acts as the final guide for the stock *h* and also strips it from the die *c*. The pad *d* is guided by the four filister head screws *e*, and is actuated by the pins *f* and the rubber spring *g*. *F* is a channel which receives the stock from the roll feed (not shown) and is inclined to allow the stock to keep with the pad *d* as it moves down when the cutting occurs and then returns to its normal position.

In operation the stock is automatically fed from a reel, which is set to the same inclination as the press, thru the roll feed into channel *F* to the die *c*. The first stroke of the press severs the metal as shown at *k* on the strip of stock *X*, the end of the stock going down with pad *d* and rising again while the piece cut off is stripped from the upper cutting die *a* by the stripper *l*. This first piece *k* is removed by hand and the strip of stock is then advanced the proper distance to make another cut as shown at *m* on the strip *X*. After this the strip is fed along automatically at each stroke until the apex of the V opening in the strip comes against the point of the gage *i*. This brings the piece in position for bending or forming, and at each stroke thereafter while a cut is being made by the dies *a* and *c* a staple is being formed by the punch *b*. It was found necessary to give the formed staple a start off the punch *b*, which was done by the spring-actuated plunger *n*, which has a curved face and is thrust aside as the staple is being formed but instantly starts the staple off the punch as the ram rises.

When this die was first put in operation the press was running 90 strokes a minute, but later it was speeded up to 125 strokes, working fully as well at the higher speed

STAPLE.

The Manchester Wage System.

Editor American Machinist:

I have been a constant reader of the AMERICAN MACHINIST for some years, but seldom see anything about Manchester, except in the reviews, and not much there, considering that it is one of the largest engineering cities in England, with such firms as Armstrong, Whitworth & Co.; Crossley Bros., Hetheringtons and a host of others, large and small.

I should like to say a few words about the conditions here, but particularly about a bonus system in vogue, which, seeing there is likely to be trouble, owing to some of the bonus systems which have come very much to the front of late, may prove of interest. The number of hours usually worked here are fifty-three a week, from 6 A. M. until 6.30 P. M., with a half-hour for breakfast at 8.30 A. M. and one hour for dinner at 1 P. M.

On Monday we start at 9 A. M., and on Saturday finish at 12 A. M. A few shops are working a forty-eight-hour week, with only one stop during the day for meals, Mather & Platt's being one of these. A number of tool shops and jobbing shops are on day's work. Others, in which most of the work can be specialized, are on individual piece work; but in a good number of shops the system which I should like to detail is in use, and has been for years, and is likely to remain.

The men are divided into groups, or jobs, as they are often called, each group under a leading hand, who gives work out to the men, but also works himself at the lathe or other machine. The price of each job is arranged between the foreman and the leading hand, often before the job is commenced.

In the erecting department a price is given for the finished machine. The men and boys draw the standard rate of wages each week, and at the end of the month the full amount of wages drawn and the amount earned are totaled up, the balance, if in favor of the men, being paid to them at so much per cent. on the total wages earned during the month. If the balance

is on the wrong side, the job is that much in debt, which must be paid out of the next balance which comes out on the right side.

The amount of balance that the masters will allow is usually 50 per cent., altho in one or two shops there is no limit at present, the men earning double and treble their rate of wages. Of course by this system the quick and slow workers get the same, if on the same rate, and it is very rare that a man gets above the club rate, unless promoted to be a foreman or leading hand.

It has some advantages, especially for middle-aged men and others who have fallen off in speed, and again, the men are willing to help each other, a feature which is usually absent when the men are on individual piecework. JOEL HOYLE.

Manchester.

[A full account of the Manchester system, called by him "general or co-operative piece work," was published in our columns for November 15, 1894, from the pen of Mr. John Richards.—Ed.]

That Jack-in-the-Box Speed Changing Device.

Editor American Machinist:

Mr. De Leeuw's article at page 1189 impels me to send you herewith the English patent specification and drawings of an invention of mine which upsets the statement made in the first paragraph of Mr. De Leeuw's article.

As shown in the plan view, Fig. 1, my device comprises two parallel shafts *A* and *B* carrying cone drums *C* and *D*, *C* being fast on shaft *B* and *D* loose on shaft *A*, so that cone and shaft may rotate independently and at different speeds. Shaft *A* in the particular construction shown also has fast and loose driving pulleys *E* and *F* belted from the main line, and a keyed pulley *G* for driving shaft *B* thru a belt and pulley *H*. Pulley *I* carries the driving belt for the lathe (or other machine) and

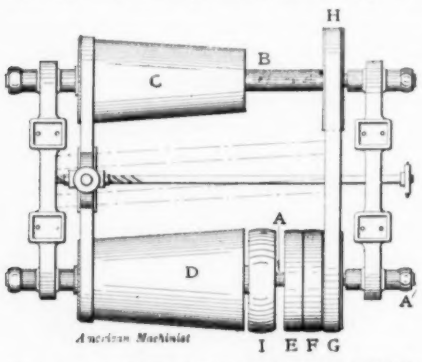


FIG. 1. PLAN OF SPEED CHANGING DEVICE.

is loose on the shaft. Cone *D*, as represented in the sectional views in Fig. 2, is equipped with a jack-in-the-box mechanism (or, as shown in the specification, may carry instead an epicyclic gear-wheel train), and one of the bevel gears is fast to the sleeve formed with pulley *I* and therefore free to turn on shaft *A*, while the opposite bevel is secured to the shaft itself, the intermediates being freely carried on studs fixed in the cone.

The belt by which cone *D* is driven from *C* is shifted by the device shown in Fig. 1; the idler bracket is tilted by guides represented by the dotted lines, to keep the belt taut at all positions along the face of cones. The position of the belt by determining the speed of *D* of course determines the speed of the pulley *I*. Shafts *A* and *B* and cone *C* may run, say, at 300 revolutions per minute and the cone *D* be driven from 300 down to 150 revolutions, or a 2 to 1 variation. With *D* running at 300 revolutions, the bevel gears and shaft *A* are practically "solid," cone *D*, pulley *I*, and shaft *A* rotating at the same speed. At 150 revolutions, or one-half the speed of *A*, the pulley *I* will be at rest. Thus with the 2 to 1 variation of cross-feed any rate of speed from 0 to 300 may be obtained for the operating pulley. With the speed of *A* increased the range of speeds for driving pulley *I* will of course be correspondingly widened.

C. V. RAPER.

Lymm, Cheshire, England.

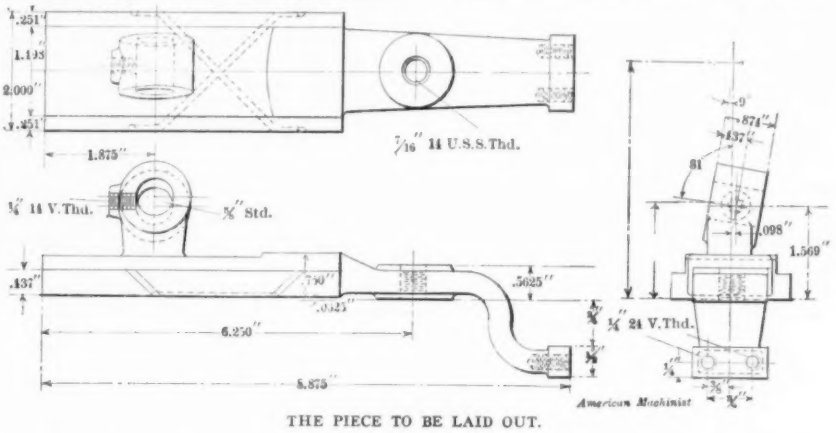
Measuring Oblique-Angle Parts.

Editor American Machinist:

Among some draftsmen it is customary to dimension a machine part having faces at oblique angles by noting the intersection of center and face lines, as indicated by the dimension lines without figures at the left of the end view of the accompanying sketch.

Having had a large experience on work of this class, I have acquired some very positive views on the subject which are well fortified by practise, and I reject the method mentioned as altogether wrong and unsatisfactory. Not wrong in theory, but wrong in practise. Theoretically it is exact to say that two lines are at such an angle with each other, and they intersect at a point so far from some fixed point, but it often occurs that this distance cannot be ascertained with any more than a near approach to accuracy.

Take, for instance, the case in point.



THE PIECE TO BE LAID OUT.

Here the angle of the hole from the horizontal and of the face from the vertical is 9 degrees. We wish to measure this piece accurately so that from our figures duplicate parts can be made. Let us attempt to locate the points where the center of the hole passes thru the face of the lug, and where the face line (produced) passes thru the vertical center line of the piece. We will find that we cannot do it without a possible error of from .005 to .010 inch and were we then to try to reproduce the piece from our figures we would again be unable to obtain absolute accuracy, making in the process a very probable error of fully a sixty-fourth of an inch.

Let us now measure the piece according to mechanical ideas. Select a point of reference wherever convenient, in this case the center of the tap hole in the lug will do very well. Ascertain its hight from the base, and its distance horizontally from the vertical center line, as shown by the dimension lines to the right in the same view.

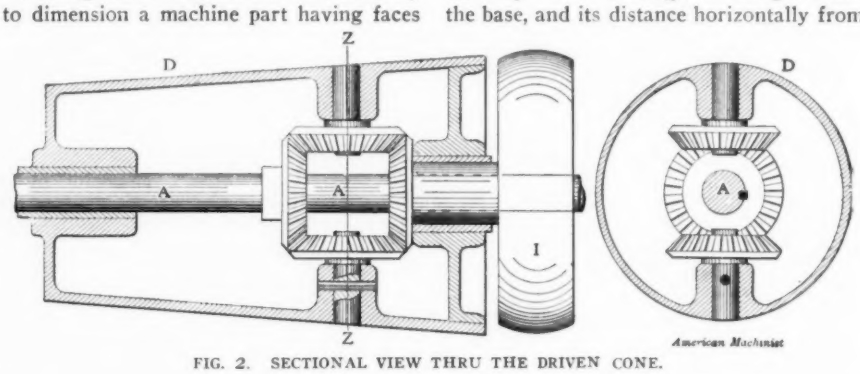


FIG. 2. SECTIONAL VIEW THRU THE DRIVEN CONE.

Now, knowing the angle, let us set up the piece with the base inclined, and with our hight gage determine the distance of the point off the center line of the hole. If on the center line, so much the better. It is here given as on the center line.

Now determine the distance of the point from one of the faces of the lug, as shown, and there you have your piece, measured simply, sensibly and, best of all, accurately, for you have a set of dimensions which you can obtain exact to a thousandth of an inch or closer, and which, when you come to making the piece, you can reproduce with the same degree of accuracy and of ease.

Here you have your fixed point, so far up and so far over, and, setting the piece at the proper angle, here you have a hole with its center line so far above, or below, or passing thru, this point, and a face so far from it.

All such pieces can be measured in just such a way, and it is, to my mind, far superior to any other method. I would like to know what the AMERICAN MACHINIST and its readers think about the matter.

HERBERT V. PURMAN.

Addition and Subtraction by the Slide Rule.

Editor American Machinist:

I have noticed with interest articles in the AMERICAN MACHINIST regarding the slide rule. Study of this but half-appreciated instrument leads to many time-saving kinks and sometimes to features of which no practical use can seem to be made. The following is a method of addition and subtraction by the slide rule—a longer process than the paper-and-pencil plan but one at the same time unique and new at least to me.

Divide one number by the other on either the upper or the lower scales, and at the end of the slide find the quotient. Taking into account the position of the decimal point, move the end of the slide to the quotient + 1, then above the number on the slide used as divisor will be found the sum. Conversely, to subtract numbers, divide the minuend by the subtrahend, subtract 1 and multiply by the subtrahend. The product is the difference sought.

Examples:

$4+3=(4\div 3+1)\,3$ or $=(3\div 4+1)\,4=7.$

$33+226=\left(\frac{226}{33}+1\right)33=(6.85+1)\,33=259.$

$139+1905=\left(\frac{139}{1905}+1\right)1905=1.073\times 1905 =2044.$

$5-3=\left(\frac{5}{3}-1\right)3=2.$

$137-6.75=\left(\frac{137}{6.75}-1\right)6.75=19.3\times 6.75 =130.25.$

MACHINIST.

[While perhaps of no particular utility our slide-rule-using readers will, we doubt not, be interested in this unique inversion of the usual operation of the instrument. Normally, the results of multiplication and division are obtaned by the process of addition and subtraction, but in the cases shown the reverse is in a sense true. The explanation of the process lies, of course, in the simple equation:

$$a+b=\left(\frac{a}{b}+1\right)b.$$

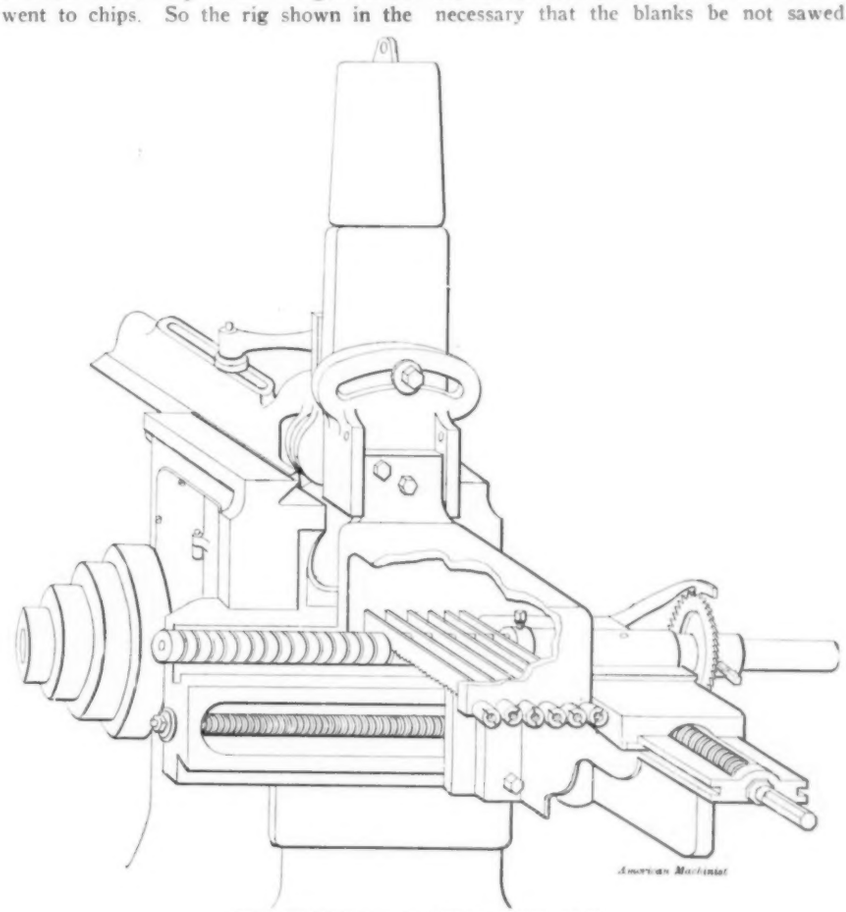
—Ed.]

The Shaper as a Power Hack Saw.

Editor American Machinist:

Seeing at page 386 a shaper rigged up as a power saw, I thought that a somewhat similar rig which has been in use in our shop for about a year might be of interest to your readers.

The work this machine is doing is cutting tool steel blanks from round annealed stock 1⅜ inches diameter. The blanks are cut ½ inch long. When we began using these blanks we punched them from flat stock. This was easy and cheap as far as labor was concerned, but wasted too much stock. Our next try was a screw machine. This was of course much better, but still about 20 per cent. of good steel went to chips. So the rig shown in the sketch was finally made and we consider it quite a success both as to labor cost and economy of stock. The object of the rig is to rotate the stock as it is being cut, with the result that a practically true, straight cut is made, obviating the squaring up of the ends so necessary when the usual style of power saw is used.



THE SHAPER AS A POWER HACK SAW.

As shown by the sketch, the clapper is removed and its place occupied by a gray-iron frame bolted solidly in position and holding six 10-inch saws each having a tightening nut and drawn quite tightly. This and their short length makes unnecessary any saw guide. The vertical feed screw is also removed and a weight substituted, giving the necessary pressure on the saws.

The vise holds a tube which serves as a bearing for the rotating sleeve thru which the stock passes. This tube yields to the pressure of the jaws of the vise and tightening them up the required amount, gives the necessary friction to the sleeve to prevent its turning under the action of the saws. The sleeve is provided with a set-screw placed close up to the saws, by which the stock is held. It is also provided with a ratchet wheel and pawl actuated by the feeding mechanism of the shaper. This is so adjusted that it turns the stock slightly while the saws are making their outward or cutting stroke. This prevents sharp corners in the cut on which the saw teeth might catch. It is of course necessary that the blanks be not sawed entirely off, as the stock would spring as the end of the cut was neared, which would jam the jaws and break them. So a stop is provided which leaves about 5-16 inch uncut. A tap with the hammer on one side of the sawed blanks does the rest. A stop (not shown) sliding into the last saw-cut as the stock is moved forward serves as a setting gage.

We find that this is not a rapid method of producing these blanks, as there is a pretty well defined limit to the feed and speed of the hacksaws; but the waste of stock is trifling, the work excellent and the labor item almost nothing, as the starting of a cut requires but a moment, after which it needs no attention whatever until time for resetting.

The saws (we use the best we know of) last surprisingly long, owing largely perhaps to the rigidity of the machine and the unyielding drive. JOHN WHITAKER.

Die Holder for Automatic Screw Machine.

Editor American Machinist:

Recently having a large number of very small screws to make (about 3-32 inch under the head) to be threaded close up to the shoulder, I found the ordinary type of releasing die-holder furnished with the automatic screw machines did not do the work at all well; the screws would be either not threaded at all or head and all threaded, with a few just right, all with the same setting of the machine. After observing the machine in operation a short time, I made up my mind that a releasing die-holder was unnecessary, as the machine reversed very accurately, and the only point where the die-holder need differ from an ordinary tool-holder would be in provision for preventing the backlash of the machine spoiling the thread.

So I had a die-holder like the sketch made and put in operation; it was a success from the start and we use no other kind now. It is a much cheaper tool to make than any releasing type, can be made of smaller diameter for a given capacity, so gives less opportunity for interference with the other tools and has no splash or clatter when in operation. The fact that with such a die-holder threads only 1-16 inch long can all day long be cut right up to the shoulder, every shoulder showing a bare scrape from the die, is of course due more to the reverse of the machine than to the die-holder itself.

Fig. 1 is a section thru the center of the holder showing a button die in place; by

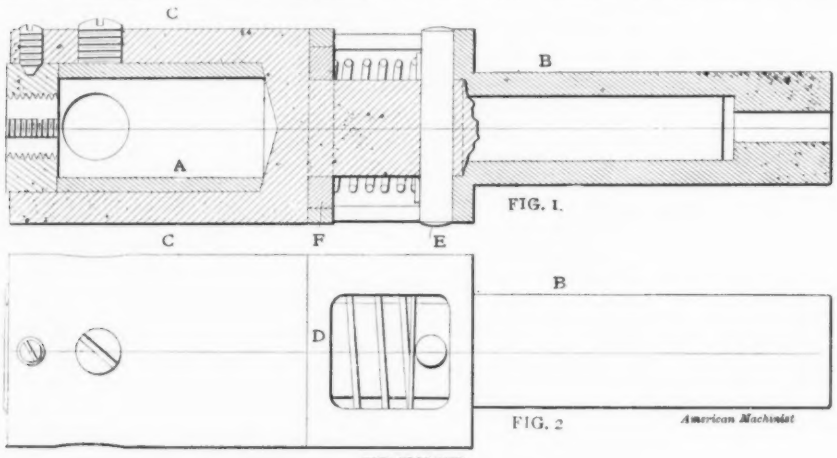


FIG. 1. FIG. 2. American Machinist

DIE-HOLDER.

removing bushing *A* spring dies can be used. The holder consists of the body *B* and head *C*; the slots *D* are cut in the body and the pin *E* is made a driving fit thru *C*. The large end of the body is bored large enough to allow for the light spring shown and the bushing *F* is forced in back of it. This spring serves to keep the holder back so it always starts at the same place; and as the die is run on and the holder *C* is pulled away from *B* thru the feed of the turret being slightly finer than the pitch of the thread, the spring is compressed and upon the reverse of the machine snaps the die quickly from the work without any danger of marring the first thread. Fig. 2 is an external view and shows the slots better than the section.

A. L. PUTNAM.

Limit Gages for Bolts and Nuts.

Editor American Machinist:

Like a bad coin, a job not completed or poorly done is bound to turn up again.

About six years ago we changed from the common V-thread to the United States standard. We considered gages at that time, and finally a threaded steel plug hardened and lapped to size, without any limit, was adopted for shop use to gage the nuts. All nuts that could not be screwed on these plugs were considered too small. (A soft plug, Fig. 1, of correct shape and size was kept in the tool department for reference.) This assured us of getting all nuts big enough, while the size of the taps, on which we allowed something for wear by making them a little over size, gave us the outside limit.

For gaging the bolts we used an adjustable gage, Fig. 2, set to fit the standard plug used for gaging the nuts. The plugs, as well as the female gages, are inspected and sealed at certain intervals in the tool department. This system, as it gave us some leeway, worked satisfactorily and was not very expensive to keep up, but it had one bad feature: it left us without a large limit on the nuts—altho this never troubled us as long as all the nuts and bolts we used were made at this plant, but now when we have to contend with nuts and bolts made elsewhere we find that

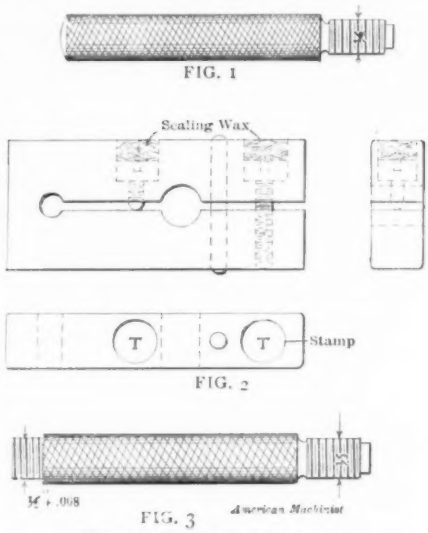


FIG. 1.

FIG. 2.

FIG. 3

GAGES FOR BOLTS AND NUTS.

there is a difference in opinion as to the amount of allowance as well as in the judgment of the different inspectors; therefore, the only way out of it is to have gages that tell what is what. But there is where the question comes in. What is the proper allowance? Should the difference between the nuts and bolts be the same regardless of the diameter, or should they be put into classes or groups, say, from ⅛ to ¼ inch and 5-16 to ½ inch, and so forth, with a different allowance for each group, or start with the smallest allowance on the smallest diameter with an increase as the diameter increases? Should the increase of the diameter of the plug gage be on both the top of the thread and the diameter of the angle, or should the diameter of the top of the thread be standard and the increase on the diameter of the angle only, or the diameter of the top of the thread be increased a larger amount than the diameter of the angle the same as all nut taps should be made?

We are trying to establish a set of limit gages for bolts and nuts, such as are made on automatic bolt-cutting and nut-tapping machines, where nuts and bolts are not fitted together but are expected to be right without having been tried. At the same time we wish to have our nuts and bolts so that they interchange with those received from other plants, if we possibly can. We have been making inquiries in regard to this matter, but have not been able to arrive at any conclusion from what we have learned; so, in order to get some light on the subject, we have been doing a little experimenting. By carefully threading studs of different diameters so that they fitted exactly into their respective nuts, then taking the size of these studs for a base we threaded more studs of each size, but reduced the diameter of each of them and threaded them so the following stud would always be .002 inch less in diameter than the preceding one, until we had what we thought to be the proper amount of looseness that we could stand for our work. From this experiment it was suggested that we allow .001 inch to each 1-16 inch of the diameter of the bolt.

For a plug gage we propose to make a double-end gage, Fig. 3, the small end to be standard size and the large end to be increased .001 inch for each 1-16 inch of the diameter of the bolt, the increase to be on the diameter of the top of the thread as well as on the diameter of the angle of the thread. The large end of this gage should have only two threads and a square

shoulder, so that any nut which can be screwed against this shoulder is considered too large. For gaging the bolts we intend to use our old adjustable gages, as shown in Fig. 2.

This, of course, is merely suggested so far, and we would like to have the opinion of the AMERICAN MACHINIST on it. It also must be understood that we intend to use these limits only where a close or tight fit is not required.

FRED J. KUHLMANN.

Putting a Rubber Band on a Band-saw Wheel.

Editor American Machinist:

The following directions for putting a rubber band on a band-saw wheel may be of interest to some of your readers: First drive a hardwood pin *A*, the size of the hole in the wheel, into the bench. Fit the ⅝-inch pins *B* into the bench outside the rim of the wheel. Cover the rim of the wheel and the inside of the band with

PUTTING A RUBBER BAND ON A BAND-SAW WHEEL.

Le Page's glue, shellac or sticky varnish. Stretch the band evenly over the pins *B*, then draw them out, letting the band back to the rim of the wheel. Now take a piece of round steel of small diameter, like a carpenter's scratch awl, and draw it around between the band and rim. Let the wheel stand over night. If canvas-back bands are used, the pins *B* must be placed nearer the rim of the wheel than if rubber bands are used.

S.

Micrometric Precision in Iron Casting — Using Steel Cores.

Editor American Machinist:

Among the interesting articles in the AMERICAN MACHINIST for the year 1902 was the one under the above heading, by Mr. Yeomans, page 1263, and Mr. Francis W. Shaw's letter on the subject, page 1760.

I had come across a few castings with very accurate cored holes in an Eastern shop, and I learned that they were cast with steel cores. I noted with wonder that the holes were not chilled, but I was not able to learn very much about how the job was done. This I learned from Mr. Yeoman's article, and when, in December, 1902, I went to work for one of the largest concerns building agricultural machinery, I kept my eyes open for a chance to see where I could try the process, and find out what there was in it.

A certain casting, we will call it AZ-53, was produced to the number of 200,000 per year. At times this casting was produced and machined in certain quantities for days, and no one ever heard of it. At other times the inspection department reported large numbers defective. The foreman who machined and used the castings hinted that if so many bad ones came to him from the foundry he would have great difficulty in filling his orders on time, and the man receiving and sorting the gray-iron scrap sent in the daily cheering report that the number of "cull" AZ-53's was a large proportion of the scrap from the entire works.

I may say that AZ-53 was about 8x11 inches and had several machining operations performed on it; one to ream out a cored hole, the finished hole being 1 inch in diameter and 3⅜ inches long. The foreman using the castings said they were warped. The foundry foreman said that a few might be warped, and he maintained that the castings were jigged too carelessly, and plenty were spoiled in that way. In the meantime the scrap sometimes amounted to 25 per cent. of the production, and on one or two occasions reached 40 per cent.

At this time improved jigs were under way, and I asked the chief draftsman if they had ever tried the steel core casting process in the works. We got a pound of the core coating and had a couple of cores made, and I tried them. At the second trial we got a beautiful casting, true, and the hole standard size. I was then told to have more cores made and to get out a hundred castings.

The castings were molded in a machine (hand-rammed), the flasks fitted together perfectly, and no long print was necessary, as in the case mentioned in this paper. I send you a sketch of the steel core we used; it was 1-16 inch longer between the prints than the sand core. In making the hundred castings, I found that it was best to drive the core out of the casting when black-hot, using a ⅞-inch brass rod and a 3-pound hammer. They came out very easily indeed. When driven out cold it was a little harder to drive them, and the core was more likely to be marred. The prints of the steel cores had to be dressed several times, as they would have changed the axis of the hole if left as marred by the driving-out process. Tho I had a 3-pound hammer used, I found it easy to drive out the steel cores, either from a cold or a black-hot casting, using an ordinary 1¼-pound hammer. The first two cores we used were simply turned and filed, and the eighteen or twenty subsequently made and used were turned and then ground to size. As the shrinkage of our iron had previously been definitely determined, it took no experimenting to find the proper size of core.

The hundred castings we made used up the can of core coating, and tho we tried to handle the cores gently, it was plain that fifty more castings would unfit them for further use, and that if we substituted a press for the 3-pound hammer, they would only last about twice as long. Every one of the holes was of standard size, but only thirty castings out of the hundred could be used. We did not make the hundred castings at once, but made from fifteen to twenty per day until they were done. Then we went over the lot carefully, and noted that the part of the casting that was "out" was in each case opposite where the gate had been, something we could not prove, except thru casting the principal hole to size. This definitely proved the cause, and since changing the method of gating there has been no further trouble. Several who had to do with the job had reasoned out the cause, but as the molding machines were in constant use, and part of the castings good, permission to alter the machines was not granted until the proof was given as above. It may be said here that in the principal machining operations on this piece the gaging was from spots or faces on the rough casting—a very common process in agricultural work.

The results we obtained were not what

A STEEL CORE FOR AGRICULTURAL MACHINE CASTINGS.

I wanted, but were conclusive enough. The chief draftsman was kind enough to say that the result justified the expenditure made in experimenting, but a few minutes' figuring on his part made it plain to me that they were very amply justified in not making further use of the process.

I can agree fully with Mr. Yeomans that the process is of value in many shops, notably small ones, manufacturing in small quantities and having fairly skilled molders and the ordinary machine tools. The square shaft job mentioned by Mr. Yeomans is not a case in point in the agricultural works I mention, and several expensive hand operations we know of cannot be cheapened by the steel-core process.

I can agree with ye editor that "in agricultural machinery the amount of drilling and boring involved is a considerable item of the entire work"; but the steel-core process cannot begin to compete with the methods in use.

I shall not lengthen this out by stating the objections to the process mentioned, but will say that in the works in question, drilling and boring are done either in special machines or in multi-spindle drillers,

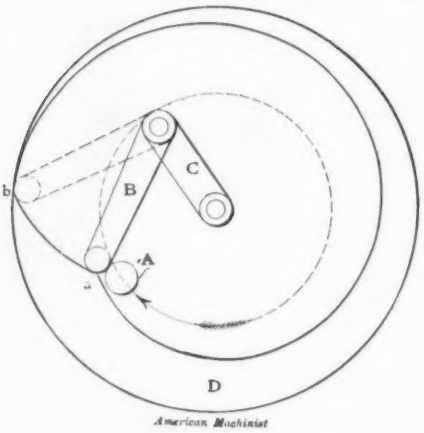
the work being flooded and rigidly held in quick-action jigs (in very many cases air clamping jigs are used). The tools used have multiple cutting edges; they are made of the brand of the new steels best suited to the job, driven at the highest speed that steel will stand, and at the coarsest feed possible at that speed, in most cases. The machine and work are so arranged that the machine tender makes the fewest moves, and can make these rapidly. Men do the heavy work, and boys the light work; in fact every production factor is considered. In addition, the piece-work price resulting from the above equipment puts the steel-core process utterly out of the question.

F. WERTHEIM.

A New Mechanical Movement.

Editor American Machinist:

The sketch shows a mechanical movement which I am using and which may interest some of your readers. As far as I know, it is new and not patented. The pin *A* moves as shown by the arrow, pushing lever



MECHANICAL MOVEMENT.

B ahead of it. One end of this lever is pivoted to *C* and the other end rests against the cam *D*. While *B* is moving from *a* to *b*, *C* stands still. The time thus lost is made up during the rest of the revolution. Thus *C* revolves around the center every time *A* does. BOYD THOMPSON.

How Should the Boring Tools be Placed?

Editor American Machinist:

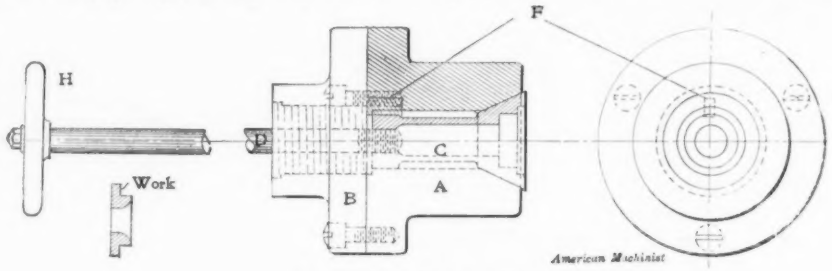
Replying to Mr. De Leeuw's question at page 1474, as a boring head is involved it is safe to assume that the object bored is a casting of some kind, and for such work remove two of the tools and place the other two opposite each other. One of these should be set to bore the size required and the other a feed or two ahead of the former and to bore such a size as will remove the scale, or larger if too much cut be thrown on the sizer or following cutter. The operator must use his judgment.

Two cutters are as effective as more and are less troublesome to maintain. Distributing the work equally between the cutters does very well in the drawing office, but in the shop it costs more than it is worth. JAMES BELL.

Chuck for Small Dies.

Editor American Machinist:

The lathe chuck shown herewith is, I think, an improvement on the chuck shown at page 1432, giving very satisfactory results on various forms of work where spring collets can be used. *A* is machine steel, hardened and ground in the hole and on the face which clamps to *B*. The collet *C* is threaded to fit the rod *D*, which is the size of and extends thru the hollow spindle of a 12-inch lathe. *C* is drawn in sufficiently to clamp the work, by means of the hand-wheel *H*, the hub of which is in contact with the outside end of the live spindle. The collet is prevented from turning when moving in or out by the feather *F*. T. W. R.



CHUCK FOR SMALL DIES.

Some Automobile Repairs.

Editor American Machinist:

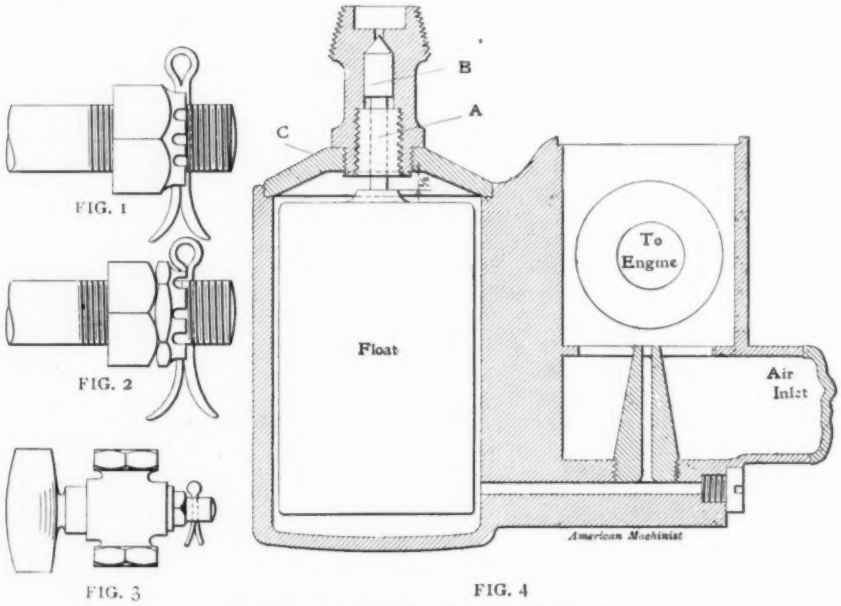
Some time ago a series of articles appeared on automobile construction, written by Hugh Dolnar, and it isn't necessary to say that they were first-class reading, and as much appreciated as his articles on bicycle construction which came out some years before. Having recently changed over a large French car, I thought some of the changes in design of details might be of interest to any readers of the AMERICAN MACHINIST who may be on automobile work. If these small matters had been looked after in the original design, the car would have given much better satisfaction.

The bolts on the connecting rod of the engine were supplied with nuts, as shown in Fig. 1. The nuts were held from backing off by the cotter pin and the constant jar caused the pin to break and the nut came off; this design was discarded for that of Fig. 2.

The valve in the pipe connecting the gasoline tank to the carburetor was an ordinary plug cock, in which the plug is held in place by nut and washer; running over rough roads caused this nut to jar off and the plug was lost. To get home, a pine plug was whittled out and a groove cut around it so that it could be tied in place with a string; this plug was replaced by one made as in Fig. 3, having a cotter pin directly back of the nut.

The connecting rod on this engine broke under conditions which did not appear to warrant such an accident, so I looked up the constants and formulas given at page 482 and found that it was too small in section. Furthermore, it was a steel casting: it was replaced by a heavier one.

The carburetor, which is of the floating valve type, would not stop the flow of gasoline from the tank, and it may be of interest to know just how to set this sort



AUTOMOBILE REPAIRS AND A CARBURETOR.

of an attachment to give enough gasoline and yet not flood the chamber. The sketch in Fig. 4 shows its construction. To set it, let the screw bushing *A* be in such a position that it will allow the valve *B* to drop from its seat about 1-32 or 3-64 inch; see that the stem on the valve is long enough to seat it when the top of the float is about ⅛ inch or so from the face of cover *C*. Don't have the threaded bushing long enough to strike the float before the valve is closed.

The cut-out clutch gave trouble by causing a violent jump when the car was started. This clutch was of the cone and shell variety, with the face of the cone covered with leather. This type of clutch is extensively used in both American and foreign practise in connection with the sliding gear transmission. To stop the jump in starting, soak it with neatsfoot oil; pull the clutch out by the lever, take an oil-can and squirt oil right in between the surface of the cone and shell. It will require a great many applications to get the clutch in good running shape, especially if it is new, but don't be afraid of the quantity, and the car will start with no unpleasant jump but have a nice, smooth action. P.

An "Open-Side" Planer Attachment.

Editor American Machinist:

The sketches show an easily applied attachment by means of which an ordinary planer may be arranged as an "open-side."

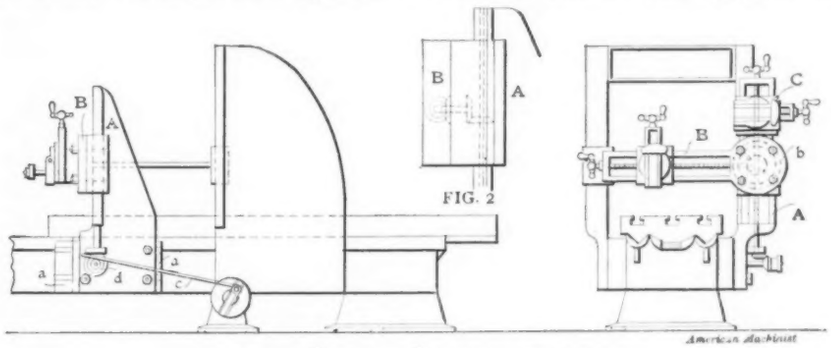


FIG. 1. AN "OPEN SIDE" PLANER ATTACHMENT.

If a new planer is built, with the intention of placing this attachment upon it at some future time, provision will be made in the casting, and in the finishing of the bed for applying it. And in this case the extra upright *A* is fitted to a specially cast and accurately planed surface *a a* at the side of the bed. In the case of an old planer, a special casting must be made and bolted to the bed, and it will be best to line it as nearly as possible, and then by a special overhanging tool-holder to plane it up true and in perfect line with the table. In either case, however, the application of the special upright will be the same. Of course it is substantially bolted to the bed, and upon it is fitted the cross-rail *B*, which has at one end the large circular extension *b*, thru which pass four bolts, whose heads travel in a circular slot, so as to permit of the rail being set at any angle desired.

Upon the upright *A* is located a head *C* with vertical travel and an automatic feed. Upon the rail *B* is a head having horizontal travel and an automatic feed, operated from the friction feed shaft by the rod *C* actuating a ratchet gear *d* which is connected by bevel gears with the vertical screw in *A*. Upon this screw (which is splined) is a miter gear, meshing with the one on the short horizontal shaft (see Fig. 2), to which is fixed a similar gear meshing into the feed screw gear in the rail, and by which the head thereon is operated. The vertical feed of the head on the upright *A* is also operated from the same source, the "throw-out" device in the head on the horizontal rail being utilized to disconnect that head, but not necessarily disturbing its position. As noted above, the rail *B* may be held horizontal, or may be set at any angle; while the head *C* on the horizontal bar will at all times be working at right angles with the surface of the table. This device may be readily attached to or detached from the planer whether it be a new or an old machine.

There is, of course, the question of torsional strain on the upright *A;* but if the circular portions of rail *B* and upright *A* are of sufficient diameter and well fitted, it will do good work even with the head at the rear end of the rail. At the same time it will be wise, when heavy cuts are to be taken, to back up rail *B* by a suitable brace from the rear upright of the machine, as a detachable shoe may be fitted and an adjustable brace arranged that will properly support the rail in any position that it may be necessary to place it.

This attachment should prove of service to many of those who have a special class of comparatively light work which it is necessary to do accurately, but which comes only once in a while, and yet is expected to be done just as if it came every day.

OSCAR E. PERRIGO.

An exchange, unidentified, tells of a mill with a first-class, 125 horse-power compound engine, which runs every day in the year, where the engineer, who is also fireman, is paid $45 a month, and the proprietor is moving for a reduction for the months which have less than thirty-one days.

The Third Annual Convention of the National Machine Tool Builders' Association.

The convention of this association was held at the Hoffman House, New York, November 15 and 16. The attendance was good and included practically all of the membership either by principals or representatives. Most of the discussions were upon business subjects and were held behind closed doors, the leading exception to this rule being the discussion upon the standardization of electric motors for machine tool driving, in which the representatives of several leading makers of motors participated by invitation. The discussion was opened by a written communication from Mr. Fred A. Geier, as follows:

"The success of direct-connected motor-driven machine tools has been thoroughly demonstrated, and they are here to stay. Much of the uncertainty connected with the design of tools suitable for motor driving has been eliminated during the past twelve months by those manufacturers of electrical machinery who have given a great deal of attention to the subject of supplying suitable motors.

"However, a satisfactory solution of the general problem has not yet been arrived at by any means, and in order to arrive at a satisfactory solution it will be necessary for us machine-tool manufacturers to first of all decide upon a *standard speed range* for variable-speed motors—speed range that will cover the entire field of machine-tool driving. This point settled, we can put the matter before the motor manufacturers, and should have no difficulty in getting them to bring out a line of such motors as a standard for machine tools. There is considerable variation in the specifications issued by the several machine-tool builders at the present time, because each of us has been struggling along as best he could and applying a motor that seemed to offer the least difficulties.

"The fact that at the present time nearly all of the more important motor manufacturers are offering what they are pleased to call a machine-tool motor with considerable speed variation thru shunt field control, indicates at once the general trend of machine-tool requirements. In order to arrive at definite figures, let us analyze the case of the milling machine. From experience we find that we need a speed variation of 150 per cent. in the motor—that is, a maximum speed of 2½ times the minimum speed. This is more speed range than is required by some tools, but probably falls a little short of the range required by others. However, it would seem that a motor that would be suited to milling machine driving would have plenty of range for any other machine tool. This will be clear from a further analysis of the problem: We require a speed range at the spindle of, let us say, from 25 or 30 to 1. By using a motor with a 2½ to 1 speed variation, and then applying double back gears to the machine, we get this speed range without any difficulty what-

ever. The method of speed variation of such motors thru shunt field rheostats supplies plenty of speeds between the gear speeds. The Ward-Leonard Company supplies these with anywhere from 35 to 120 steps or speeds on small motors. The back-gear problem simplifies itself on those machines that require less speed range.

"The Cincinnati Milling Machine Company have standarized the electric drive arrangement for their milling machines, and are at the present time prepared to supply any size of miller with any one of half a dozen of different makes of direct-current, variable-speed, shunt-wound motors with a 2½ to 1 variation in speed, and are thus in a position to meet the wishes of practically all their customers in regard to the selection of a motor.

"But this does not completely end their trouble, because every one of the half dozen motors that they can use with their arrangement is entirely different in shape and size than any one of the others. It is therefore necessary to make up special parts to suit the particular motor specified on every order. This prevents them from standardizing all parts and carrying them in stock, and therefore increases the cost of the motor-driven machine considerably over what it would be if all makes of motors of given horse-powers had frames that were standard in certain important particulars. In order to manufacture motor drive parts for machine tools economically, by making them up in lots for stock, motor frames must be standardized in the following respects:

"First—Size and shape of the base.

"Second—Distance from the center of the driving pulley to the center of the base.

"Third—Hight of the motor from the bottom of the base to the center of the armature shaft.

"Fourth—Diameter of the armature shaft.

"For a standard speed variation we believe that 2½, or at the most 3, to 1 would be entirely satisfactory to meet the general problem, and these speeds should of course be kept as low as possible, with a minimum speed somewhere below 700 revolutions per minute.

"After a little thought it will be obvious that this standardization of motor frames will not involve great expense to the motor manufacturers, since with the single exception of the armature shaft, it is entirely a question of *size and location of the base of the motor* with relation to the center of the pulley.

"The advantages of such a standardization are at once apparent to all machine tool builders, as it would enable them to standardize their motor drive arrangements, carry all parts in stock, and therefore considerably reduce the present cost of motor-driven machines. It would also be of equal advantage to the manufacturers of electrical machinery, as it would enable each one of them to enter into competition on an even basis with all the others for supplying motors for driving tools. It will also enable them to go ahead at once and make up these motors in large quantities and carry them in stock, especially for machine-tool purposes, and they could thereby reduce the cost of these considerably over the present method of making each motor to order. It is obvious that a combination of the reduced cost of motor and the reduced cost of the tool, as a result of standardization, will also materially reduce the now almost prohibitive selling price of motor-driven machine tools.

"There is one other point—delivery. At present prospective purchasers who have about decided to buy become much discouraged and often drop the matter entirely, because of the fact that they must wait a long while for delivery, because both the tool builder and the motor manufacturer do not have parts in stock. All this will be eliminated by standardization.

"Motors for machine-tool drives must be standardized in the very near future, and the sooner this is done the better it will be for all concerned. If specifications can be decided upon now and the matter carried thru, it will enable both the machine-tool and motor manufacturers to carry parts in stock, make prompt deliveries, reduce their costs, and therefore lower their selling price to such an extent as to have an immediate direct influence and result in an increased sale of electrically driven tools."

The discussion was continued by Mr. W. H. Powell, representing the Bullock Electric Manufacturing Company, who spoke as follows:

"There are on the market to-day several different systems for operating variable-speed motors.

"First—The single voltage system, in which speed variation is obtained by field weakening. In this system variation in speed as high as 6:1 has been obtained by special motors.

"Second—The three-wire even voltage system, in which system speed variation of 4:1 is obtained.

"Third—The multiple voltage systems, consisting of three and four wires, in which systems a speed range of 7:1, or as high as 10:1 is obtained.

"In determining the proper speed variation for motors driving machine tools there are two points to carefully consider:

"First—In all of these systems, and also for motors operating at a constant speed, the size and weight of the motor is dependent to a great extent on the minimum speed at which the motor is required to develop its full rated power; and the slower the minimum speed the greater will be the size and weight for a given horse-power output. For example, if a given frame and armature core when wound for 1,000 revolutions per minute will develop 10 horse-power output at a constant speed and continuous service, it will develop only 5 horse-power when wound for 500 revolutions per minute constant speed and continuous service.

"Second—As a gear or chain drive is used on motors operating machine tools, the maximum speed of motor is dependent on the tooth speed of the motor pinion, or chain sprocket; or upon the maximum ratio of speed reduction between the driven shaft and the motor shaft. The maximum speed of the motor on most machine tools varies from 1,000 to 1,800 revolutions per minute; and, assuming 1,500 revolutions per minute is an average value for the maximum speed, we will endeavor to show how the output of a given size motor frame and armature core varies on the different systems of speed control, and also when operated at different amounts of speed variation.

"We will assume that a given frame when wound as a constant speed motor at 1,000 revolutions per minute will have an output of 10 horse-power for continuous service.

SINGLE VOLTAGE.

"When suitably wound for a variable-speed motor, to be operated on single voltage, this frame will give an output of 7½ horse-power, with speed range from 750 to 1,500 revolutions per minute; and when suitably wound for a speed variation of 3:1 it will give an output of 5 horse-power from 500 to 1,500 revolutions per minute. In both of these cases the overload capacity at the lower speeds for intermittent duty would be not over 20 per cent., while at the higher speeds the overload capacity is practically zero. For machine-tool work the rating of the 2:1 motor would be 7½ horse-power, and the rating of the 3:1 would be 5 horse-power.

THREE-WIRE EVEN VOLTAGE.

"The speed range of a motor operated by this system is 4:1, and the motor would have a rating of 3.75 horse-power from 375 revolutions per minute to 750 revolutions per minute, and 7.5 horse-power from 750 revolutions per minute to 1,500 revolutions per minute. Its horse-power rating thru the entire range of 4:1 would be, therefore, 3.75, and the horse-power rating throughout a range greater than 2:1, and less than 4:1, would also be 3.75 horse-power. A motor when operated on this system has an overload capacity for intermittent loads of from 15 to 20 per cent., at speeds from 375 to 500 revolutions per minute. The overload capacity at the speeds from 500 to 750 revolutions per minute is practically zero,, so that the rating of the motor for machine-tool duty would be 3.75 horse-power.

MULTIPLE VOLTAGE SYSTEMS.

"The multiple voltage systems have an advantage over the three-wire, even-voltage system, in that they can be operated at partial-speed ranges with an increase in the capacity of the motor. If oper-

ated thru a speed range of 2 : 1—that is, from 750 to 1,500 revolutions per minute—the motor would have a rating for a continuous duty of 7½ horse-power. It can be overloaded, however, at least 50 per cent. for a short time at any point in the speed range without overheating or without serious sparking. For the intermittent loads of machine tools the motor could have a rating of 10 horse-power. If the speed range were increased to 3 : 1 and the motor operated from 500 to 1,500 revolutions per minute, it would have a rating of 5 horse-power for continuous duty; but for machine tool duty it could be rated at 7½ horse-power throughout the range. If the speed range were increased to 4 : 1, and the motor operated from 375 to 1,500 revolutions per minute, it would have a rating for continuous service of 3.75 horse-power; but for the intermittent duty of machine tools, it would have a rating of 5.5 horse-power throughout the speed range. It will thus be seen that for a given horse-power output, the size of frame and weight of machine can be greatly reduced if motors are operated on the multiple-voltage system compared with either the single-voltage or the three-wire even voltage, provided the speed range is the same. The multiple-voltage systems, however, require a separate balancing set and an increase in the number of the transmission wires to the motors.

"There is, therefore, a great demand for variable-speed motors operated on the two-wire system. For this system, motors with special commutating poles or compensating coils have been placed on the market with a speed range as high as 6 : 1. A properly designed motor without these special parts can be operated thru a speed range of 3 : 1 without undue heating at the lower speeds, and without sparking at the higher speed; but no matter what the design of motor or the method of speed control, the size and weight, and consequently the cost, is dependent on the slowest speed at which the motor is required to develop its full rated power.

"It is therefore desirable to keep the speed range down to a reasonable amount, which in our judgment is 3 : 1, with a minimum speed of 400 to 600, depending on output of motor."

Mr. Fernold, of the Northern Electric Manufacturing Company, advocated the single-voltage system and controverted some of Mr. Powell's statements regarding the permissible overload of such machines. Mr. McGuire, of the American Electric & Controller Company, stated that the average demand, as experienced by his company, was for a speed range of 4 to 1. Mr. Rierton, of the General Electric Company, said that the motor manufacturers look to the machine tool builders for relief from a troublesome situation and hoped they would agree on standard specifications. He referred to a similar condition which existed some years ago between engine and generator makers, which had been successfully met by a set of standard specifications which had been drawn up after consultation between the parties, and which had in many cases cut the time of delivery in half. Similar sentiments came from the representatives of other electric manufacturing companies, who expressed a desire on the part of their companies to co-operate in bringing about a solution of the difficulties which are equally annoying and expensive to both parties.

At the conclusion of the discussion a motion was carried for the appointment of a committee to draw up a set of standard specifications for motors for machine tools. This committee will no doubt act in conference with representatives of motor makers, tho just how the latter representation will be arranged is not yet settled.

A discussion of the tariff followed the passage of this revolution. A strong sentiment for lower duties led by Mr. Montanus was developed, this going so far, in some cases, as an advocacy of the removal of all duties from the goods made by the members of the association. The hostile tariffs of Canada, France and Russia were referred to and the sentiment was strong that something must be done. At the conclusion of the discussion a resolution was passed referring the matter to the Executive Committee.

The following resolutions were also passed:

"Resolved, that in order to prevent cancellation of orders by dealers, it is the sense of this association that the placing of large stock orders by dealers be discouraged and that each member is competent to best manage his own personal interests on this subject.

"Whereas, a proposition has been received by the association to become owners and managers of an establishment for the manufacturing of large machine tools,

"Resolved, that it is impracticable for this association as an association to become the owners of such a plant."

In the matter of prices of their products the association passed a resolution reciting that raw material is increasing in price, that the rate of wages remains the same as during the past year, and instructing the Executive Committee to keep watch of the market, to keep the association informed thereon and, if necessary, to call a special convention to consider the subject of prices.

At the concluding session Mr. Walter Carter, representing Sir W. G. Armstrong, Whitworth & Co., delivered an address on the capabilities of his firm's "A. W." high-speed steel and exhibited many interesting specimens.

On Tuesday the association was entertained at luncheon at the Hoffman House by the AMERICAN MACHINIST and on Wednesday they were given an excursion thru the subway on a special train by *Machinery*, an unique feature of the second entertainment being a luncheon underground and within the train. By mutual courtesies representatives of each paper were present at the entertainment of the other.

National Founders' Association Defines its Position.

At the meeting in Cincinnati, November 18, of the National Founders' Association an announcement was issued of which the following are the principal features:

"Inasmuch as certain practises, insisted upon by labor organizations, tend toward counteracting the energy, ability, inclination and opportunity of molders to earn greater compensation than they are now receiving, it shall continue to be the policy of the association not to permit the limitation of a man's earning capacity, whether he is working by the day, by the piece, or premium system, thus protecting our workmen in a desire to improve their conditions.

"Believing the action of labor organizations in inflicting upon their members fines and punishments for accepting opportunities of advancement and increased earnings offered by the foundrymen is a practise tending toward a deterioration of the ability of the individual workman, this association hereby reaffirms its determination to prevent the imposition of fines and restrictions placed on a molder for the purpose of handicapping him or retarding him in any way from putting forth his best efforts to produce the best quality and quantity of work in the shortest time, and receiving a proportionate compensation.

"Employees will be paid by the hourly rate, by premium system, piece work, or contract, as the employers may elect, and the workmen so employed will be required to give a fair day's work for a fair day's pay.

"It is the privilege of the employee to leave our employ whenever he sees fit, and it is the privilege of the employer to discharge any workman when he sees fit.

"The number of apprentices, helpers and handy men to be employed will be determined solely by the requirements of the employer.

"It shall be the right of the foundryman to introduce molding machines and appliances of any kind and to have the same operated by whomsoever he finds to his best advantage to employ thereon.

"Disapproving absolutely of strikes and lockouts, the members of this association will not arbitrate any question with men on a strike. Neither will this association countenance a lockout on any arbitrable question unless arbitration has failed."

The pay car of the Lake Shore & Michigan Southern Railroad has just made its last trip over the road and hereafter all the employees are to be paid with bank checks.

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Contents.

	PAGE
Notes from the Jones & Lamson Shops	1557
Machine Molding a Special Gear—Fitting the Pattern	1560
Highest Award	1562
The Ideal Blacksmith Shop and Equipment for General Railroad Work	1562
Design of a 4,000-Ton Hydraulic Press—II	1564
To Sink a Shaft Twelve Miles Deep.	1567
A New Gear Cutting and Worm Wheel Generating Machine	1569
Letters from Practical Men: Dimensions on Drawings....The Accident to the St. Louis....Split Nuts for Use in Driving Threaded Work....A Light Track Ladle ....Radial Stresses Due to Centrifugal Force in Revolving Bodies....Automatic Die for a Three-Pronged Staple....The Manchester Wage System....The Shaper as a Power Hack Saw	1570-1579
The Third Annual Convention of the National Machine Tool Builders' Association	1579
National Founders' Association Defines its Position	1581
Standard Motors for Machine Tools.	1582
The Tool Builders and the Tariff...	1582
The High-Speed Test at the St. Louis Fair	1583
Some New Things	1583
Technical Publications	1586
An Engineer Electrocuted	1586
Personal	1586
Obituary	1587

Standard Motors for Machine Tools.

The discussion before the National Machine Tool Builders' Association on the subject of Standard Motors for Machine Tools which we reproduce in another column is, we take it, first of all an illustration of the large field of usefulness for the association. Here are two parties, the machine tool and the motor builders, both of whom are subject to the annoyance of an expensive and troublesome nuisance leading to increased cost and decreased profit to both, while the purchaser is between the upper and the nether millstone and is compelled to pay higher prices, and to submit to vexatious delays while drawings and patterns are altered and special motors are made for his machines. The larger portion of this condition of affairs can be overcome by so simple an expedient as standardization of the size and position of the feet of the motors, and it will be a reflection on the intelligence of one or both parties if it is not done. However, we do not doubt that it will be done, just as, a few years ago, a similar thing was done between the makers of dynamos and engines. The two situations are exactly alike except that the present one is more important to the degree that machine tools and small motors are more numerous and are more largely built by manufacturing methods than are engines and dynamos. In the matter of standard speeds and speed ratios the case is less simple and we have a less hopeful view of the outcome, but these features, while the most difficult to cover, are probably the least in importance.

Not the least satisfying feature of the discussion was the acknowledgment of the necessity for some action by the representatives of the motor building companies present. As one put it, they are "seeking relief" from bad conditions at the hands of the association. The case would seem even stronger to them did they know the machine tool builder's side of the case in full. It is no secret and, indeed, it was stated in so many words by one prominent machine tool builder at the convention, that the machine tool men are very much discouraged with this whole subject of motor driving. To few, if any of them, has it been a source of profit; to some it has been a source of loss, and to all it has been a nuisance. Most of them from a business standpoint want as little as possible to do with motor driving and some do all in their power to dissuade their customers from adopting it. Add to this the present high cost of motor-driven tools and the long delays involved in having them and their motors made to order, and the motor manufacturers should, and doubtless will, recognize that in the condition which this movement sets out to remedy lies the chief obstacle to the extension of motor driving.

With the interests of both parties identical and with the promise of the removal of a serious handicap to the business of both, it is not to be imagined that they will fail to get together and agree upon standards which are certain to have far-reaching effects upon the extension of motor driving in machine shops. It is not, indeed, necessary that all of either party should accept the standards at the start, as, if a fair proportion do, the others will soon be compelled to fall in line. With the standards established and in use, it is certain that any motor builder who refused to adopt them would quickly find the demand for his motors to drop off and the increased cost of adhering to present methods would have the same effect on the recalcitrant machine tool builder.

Were the National Machine Tool Builders' Association to do nothing in the first five years of its existence but bring about the proposed standards, it would justify its existence and deserve well of the machine tool building fraternity. It is only by such associations that such movements can be inaugurated and carried thru, and we recall no recent instance in which the usefulness of such associations has been so well shown.

The Tool Builders and the Tariff.

A discussion which took place during the recent meeting of the National Tool Builders' Association regarding the effect of the tariff upon the business of the members is, it seems to us, especially significant and should not be passed over without attention. With scarcely a dissenting voice the sentiment was expressed in the strongest and most direct language that a duty of 45 per cent. on machine tools was not only not needed for the protection of American tool builders at home, but was a direct and positive hindrance to them in their foreign business. Particularly they referred to it as calculated to cause the enactment and maintenance of retaliatory tariffs by other countries and they directly charged that the present very unsatisfactory condition of our machine-tool business with Russia was clearly chargeable to our own foolish and totally unnecessary tariff schedules.

The sentiments expressed during this discussion showed clearly enough that the present attitude of our machine-tool builders is the same as in 1900 when in reply to direct questions which we addressed to them they, with practical unanimity, declared that they did not need any tariff and that it was a hindrance to them in their foreign business.

Tho we have taken no poll of the members of the association referred to, or of the machine-tool builders of the country, we take it that a very large majority of them believe in the principle of protection and belong to the political party which stands for that principle. They simply look at this matter from a business standpoint and express their views upon it only so far as it relates to their own business; and thus far they are justified in holding decided views.

That men holding such views need not in these days consider themselves thereby

debarred from being members of the Republican party in good and regular standing seems clear from what leading men and newspapers of that party are saying, as witness the following extract from an editorial article published in the *New York Tribune* of November 16, as follows:

"The Dingley act was passed nearly eight years ago. Since then a wonderful development in American manufactures and commerce has occurred. No wise and patriotic man can wish to arrest that development, but he must realize that in some respects the country has outgrown the law, and that in some other respects, as experience has demonstrated, the law was faulty from the beginning. The iron and steel schedules have certainly been outgrown and need revision. Some tinplate manufacturers concede that they do not need any longer the measure of protection which they receive. The leather duties, which were intended to protect cattle raisers, seem by a miscalculation to have resulted in hampering the manufacture for export of heavy leather goods made from thick South American hides and in making those goods unnecessarily dear at home. Then more and more the people realize the shortsightedness and folly of taxes on books and art. The supposed beneficiaries of these taxes almost unanimously demand their repeal. Our duty to the Philippines and our self-respect also prompt the opening of our doors to their trade. Their prosperity is the solution of our insular problem."

Of course it is yet to be seen what the men who control the steel trust will have to say to any commission or committee who proposes to modify the "outgrown" steel schedule. We can imagine something about it, however, and perhaps our tool builders would take much the same attitude if they also were in a position to be exempt from the pressure of competition. But they are not and are not likely to be; therefore they demand to be unshackled and given a fair chance all over the world. If given this chance we have no doubt whatever they will give a good account of themselves. They are not seeking to ruin their own business but to improve and develop it. They think they know how it should be done, and probably they do know.

The High-Speed Steel Test at the St. Louis Fair.

We have received a copy of the report of the committee appointed to conduct the much heralded test of high-speed steels at St. Louis, but do not regard it as worth publication. There is much in connection with the test which it is impossible to understand. After appearing at the meeting at which the rules of the test were drawn up, most of the contestants failed to appear at the trial, which was finally conducted with but three brands of steel. Of course those who did compete may honestly claim that the others withdrew because they feared to go on and that the winner is still entitled to the honors of the game. While, in a technical sense, this is true, it is also true that a test between but three steels and with many of the best known brands left out has very little significance to those who must select from all the brands on the market.

Of even more importance in vitiating the value of the results than the withdrawal of most of the contestants is the nature of the tests. The tabulated results of the observations show that the longest duration of cut was 1 minute 55 seconds, the other figures running down to 10 seconds. The reason for suspending the runs after these short intervals does not appear, but, in accordance with the regular procedure in such tests, it is only fair to assume that the suspension was due to the failure of the tools. Assuming the steels to have been capable of good work, it still follows that tests under conditions which permitted such short runs only cannot be regarded as in any sense conclusive, even among the steels tested. Moreover, comparisons under this assumption are not possible, as the tools were not operated until their final conditions were the same. Thus we find one column of the tabulated results giving the length of the run and another giving the comparative conditions of the tools. How any conclusions of value can be drawn from tests in which both the duration of the cuts and the final condition of the tools varied is more than we can understand.

To our mind the incident illustrates, first of all, the futility of attempting to conduct tests of this character under the conditions that obtain at a world's fair.

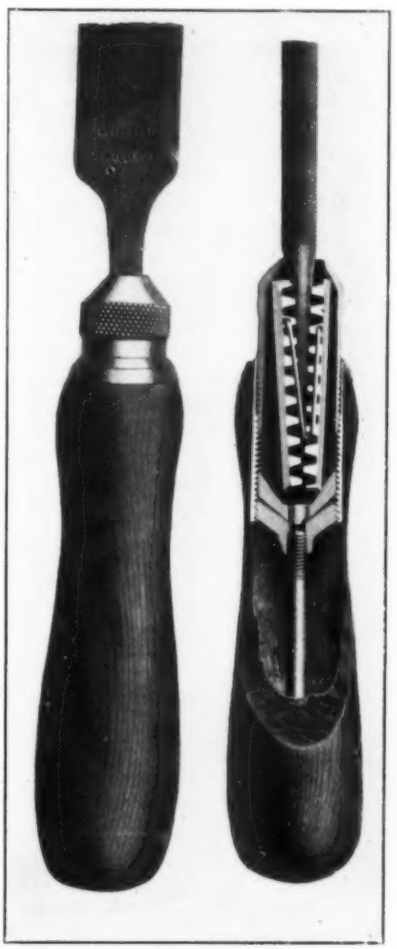
The Engineer, of London, referring particularly to the paper by Irving H. Reynolds on "Pumping Machinery," presented at the recently held Engineering Congress, reviews the whole subject of pumping engine economy as exemplified in American practise and finally says: "Taken as a whole, it is certain that the United States pumping engines are the most economical of fuel in the world. We are not certain that their pumps are equally excellent. That further economies may be effected in the use of steam is possible, but there is good ground, we think, for saying that 10 pounds of steam per indicated horsepower per hour must be very near the lowest limit consistent with commercial practise."

The attendance at the St. Louis fair during the month of November has not, we believe, been such as to encourage the repetition of the experiment of keeping expositions open so late. Visitors there about the middle of the month found the attendance very light indeed, the spaces between the buildings being at times strongly suggestive of the deserted village. A large proportion of Machinery Hall seemed also to be deserted. Some of the exhibits there had had no attendant in them for some time, and it was understood that some of those who had been in charge of exhibits there, had gone home in the belief that it would not pay to stay longer. Even many of the "Pike" shows had closed, and the general impression was one of dreariness and gloom.

Some New Things.

ADJUSTABLE FILE HANDLE.

The half-tone shows an adaptable file handle recently patented. The shank of the file or other tool is slipped into the opening and a turn of the projecting



A NEW FILE HANDLE.

nurled end of the rotating sleeve fastens it securely, the operation being easily understood from the sectional view. A metallic socket with an internal thread is permanently fastened in the handle by the long screw from the butt of the handle. In this is inserted a collar with an inverted conical surface and upon this is dropped a pair of toothed jaws, as shown, normally distended by the wire spring. The sleeve with the nurled head is then screwed in, completing the handle. The internal conical end of this sleeve closes the jaws at the front end, while they are closed at the other end at the same time by contact with the conical surface of the inserted collar. It will be seen

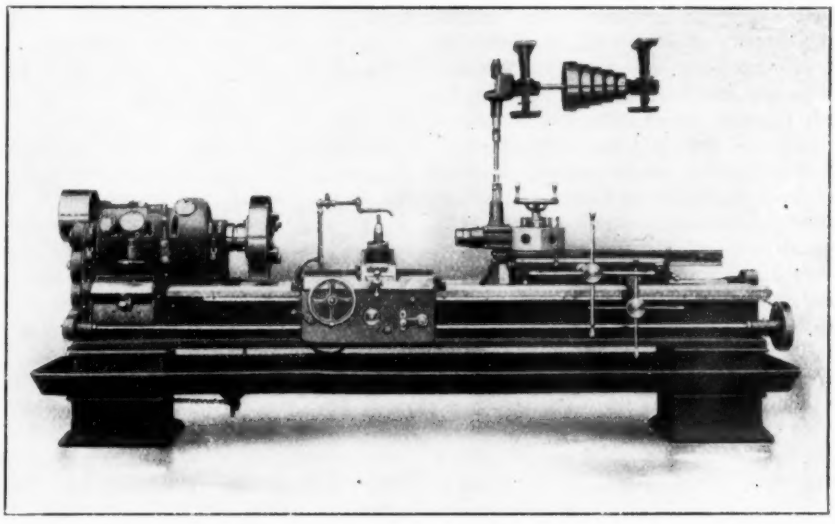
that by this arrangement the jaws readily adapt themselves to different shapes and tapers of shank. Dewitt Tappan, South Bend, Ind., is the inventor.

THE "CHERRY" AUTOMATIC CHUCK.

This chuck is either universal or independent in its action, is equipped with reversible jaws and has a capacity equal to that of any ordinary chuck of the same diameter. It is adapted for handling a wide range of parts, such as pulleys, gears, pipe flanges, collars, hose couplings, etc., and is suitable for screw machine work and bolt cutting. The jaws are self-centering, have a powerful grip and are opened and closed upon the work by means of a lever (shown in Fig. 1) without stopping the machine. The chuck body is cast in one piece and can be attached to any ordinary lathe or screw machine. The jaw proper (see Fig. 2) is composed of two parts; first, that which holds the work and which is threaded for the screw; second, that which opens the jaw and closes it upon the work and which is made with a projection fitting into a circumferential groove in the screw. The back side of this second part is recessed to receive the end of a rocker lever, which is pivoted upon a stout pin and which is actuated to close the jaw by means of a shoe that slides in a longitudinal groove in the hub of the chuck, and whose upper surface is an inclined plane upon which the long end of the lever rests. This wedge-shaped shoe for each jaw is slid back and forth to open and close the chuck thru the action of a ring and lever, the connecting parts of which are shown in the different views. The chuck is manufactured in three sizes, of 8, 10 and 12 inches diameter, by Radford & Larson, 102 Pearl street, Boston, Mass.

LATHE WITH TURRET AND SPECIAL BORING ATTACHMENT.

The accompanying half-tone illustrates an interesting machine built by the American Tool Works Company, of Cincinnati, Ohio, and consisting of their 22-inch lathe with all-geared head, equipped with pan, oil pump, turret, and special boring device. The entire screw-cutting mechanism has been omitted, as the lathe is primarily intended for roughing and boring, and the feeding mechanism, while of the same principle as that regularly incorporated in the "American" lathes, is of a special nature. There are seven carriage feeds, ranging from .015 to .2 inch per turn of spindle and graded to suit the roughing and boring operations planned for this lathe. In the geared head only six gears are required to obtain four speeds thru levers shown at the front. This simplicity of construction enables the gears to be made of wide face and large diameters, this giving the entire mechanism sufficient strength to transmit the maximum power delivered to the machine by a 6-inch double belt. The four speeds obtainable thru the head, in connection with a triple friction countershaft, supply twelve distinct speeds to the spindle, ranging from 5 to 322 revolutions per minute. The carriage is fitted with a plain block rest, which is provided with an interesting system of stops. This consists of a set of four adjusting screws attached to the rest after the manner of eyebolts, each one falling, when desired, into corresponding slots in the yoke over the front dovetail of the carriage. By adjusting nurled lock-nuts on any of the four screws and dropping them into the slot the travel of the cutting tool toward the center, and hence the diameter to be turned, is limited at pleasure. This attachment is very valuable in duplicate work, as adjustments can be made for duplicate turning of pieces with four shoulders.



22-INCH LATHE WITH TURRET AND BORING ATTACHMENTS.

The hexagon turret is provided with power feed driven thru sprockets and chain from the feed rod and giving fourteen feeds ranging from .007 to .16 inch. The worm is dropped out of mesh with the wheel by a tripping device adjustable from the front of the machine. The turret slide has in its block a 24-inch movement controlled by the pilot wheel, and is supported at the front end by a shoe which slides on the ways and is bolted to the end of the turret slide directly under the cutting tool. It insures accurate alinement in boring and has a gibbed bearing both at the top and bottom of the ways, thus preventing spring in any direction. The drilling attachment is affixed to one of the faces of the turret, and consists of a housing car-

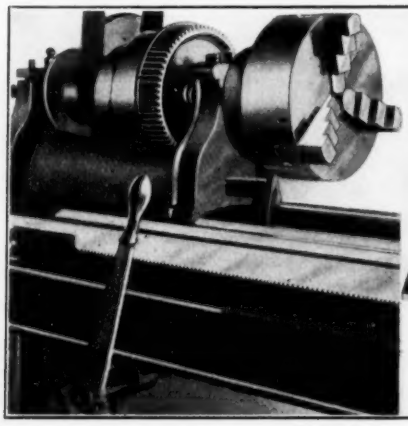


FIG. 1. FRONT VIEW.

FIG. 2. THE CHUCK AND ITS PARTS.

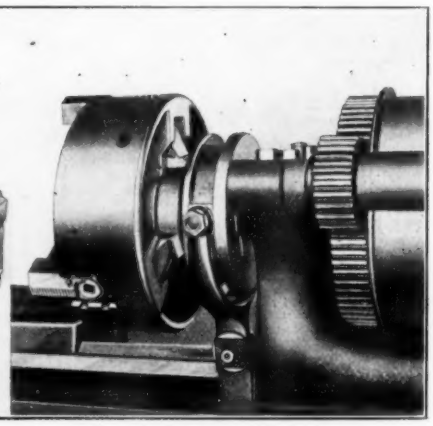
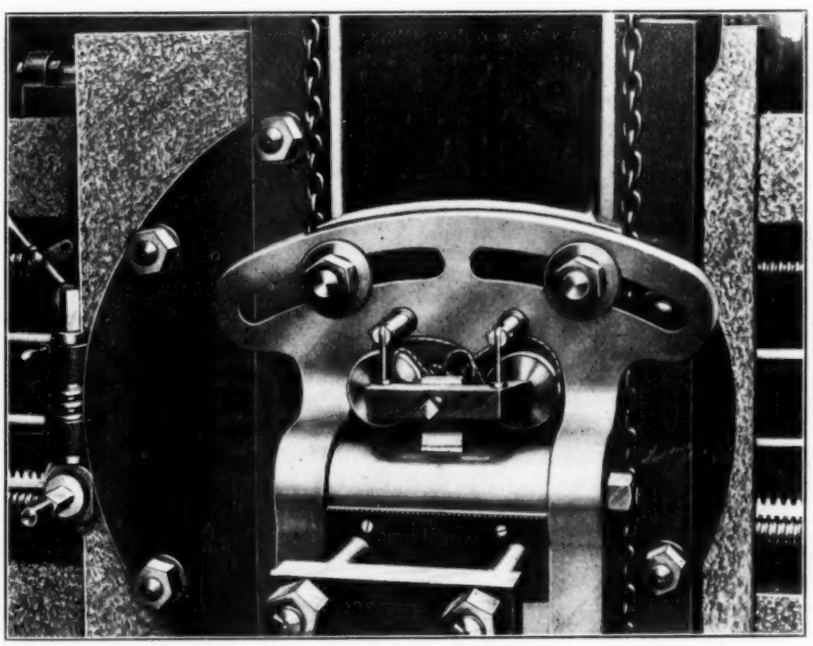


FIG. 3. REAR VIEW.

rying miter gears which actuate a spindle with ball-bearing thrust which carries the boring bar. The spindle is made to rotate from a separate countershaft, as shown in the illustration, by means of universal joints connected by a telescopic rod, which thus compensates for any movement of the turret slide and turret. The boring spindle rotates in the opposite direction to the main spindle on the head, and has five rates of speed thru the cone pulley on the countershaft. The boring tool is provided with oil drawn by an auxiliary pump thru the turret stem and boring bar. The carriage has a similar oil supply for the turning tool.

MAGNETIC RELIEF FOR PLANER TOOL.

This device has been applied by the Niles Tool Works to a 14-foot planer and consists of an electro-magnet and armature, the former being fastened to the clapper box and the latter suspended by a pair of links directly in front of the magnet and straddling an arm projecting from the top of the clapper. The electro-magnet attracts the armature and thus swings up the tool just at the point of reversal of the platen for the return stroke, the energizing current being led in thru a cord from a lamp socket, and at the end of the idle stroke the armature and clapper are again released. The amount of lift or clearance for the tool is regulated by a stop screw thru the armature. A small switch is provided by means of which the device may be thrown out of action at any time desired; and the clapper may be swung up for renewal of tools, etc., without in any way disturbing the arrangement.



MAGNETIC RELIEF FOR PLANER TOOL.

AN INCLINABLE PUNCH PRESS.

The illustrations show an inclinable press designed to withstand the hard usage generally allotted to presses for general manufacturing. The various parts of the clutch are made of steel, and those subject to wear are hardened. It can be readily taken apart for inspection by sliding the flywheel toward the end of the shaft.

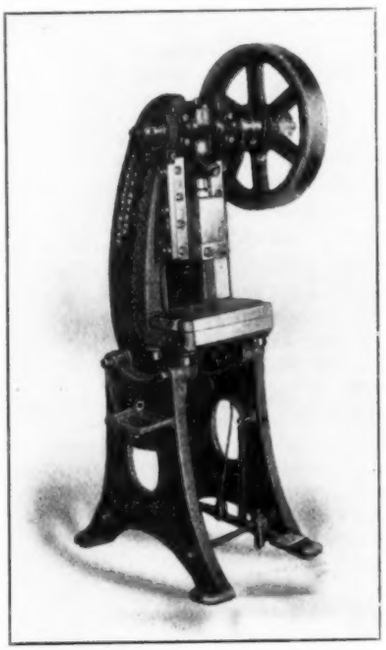


FIG. 1. INCLINABLE PUNCH PRESS.

There is a safety clutch lock which permits the setting of dies without throwing the belt off. The flywheel is bronze bushed and has continual lubrication accessible while the wheel is in motion.

The end of the pitman is a ball joint which is adjustable for wear. The threaded end of the pitman is securely locked in direction of the thrust by a set-screw and threaded shoe.

The inclined position is obtainable by means of a hand-wheel and screw, the working hight remaining nearly the same in all positions. A knockout, adjustable from the front of the press, can be attached to the slide. A tool shelf and the necessary wrenches are supplied with the press.

The manufacturers are Zeh & Hahnemann, 213-219 Chestnut street, Newark, N. J.

Practical Experience With the Steam Turbine in Marine Work.

For marine service the first acquaintance of Canadian engineers with the steam turbine is in the work of the steamer "Turbinia," which has been running between Hamilton and Toronto for a part of the season now closing. She has run daily without accident, and her engineers are highly satisfied with her performances.

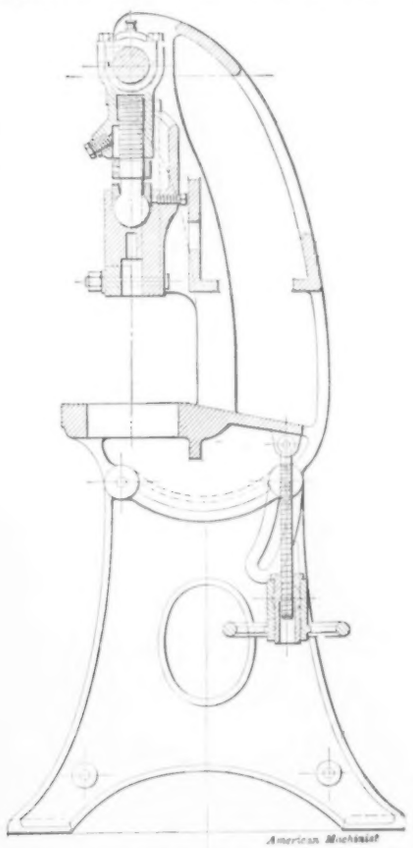


FIG. 2. SECTIONAL VIEW OF INCLINABLE PRESS.

Her coal consumption has averaged 2.21 tons per hour under a speed of 23 miles per hour, or 1.48 pounds of coal per indicated horse-power per hour. The "Turbinia" is a vessel of 1,060 tons gross, and has engines of 3,400 horse-power. Passengers on the "Turbinia" are sensible of a vibration, but this is a vibration of a different kind from that due to the motion of the crank and piston of a reciprocating engine. It is believed that this quivering can be greatly reduced by a special arrangement of the bearings of the propeller shafts.

Apart from economy of coal when running at high speeds, the chief points in which, in the opinion of the engineers of

this boat, the turbine engine is superior to the reciprocating are: the smaller space required for engine and machinery; greater simplicity of the parts of the engine and less liability to breakdowns; reduction of weight of machinery; reduction in the staff of engineers, and no vibration of the kind to which a reciprocating engine subjects a ship. Two engineers run the "Turbinia," but it is stated that the reduction on a larger boat would be greater in proportion to tonnage. An Atlantic liner of the modern type would require seventeen engineers with reciprocating engines against ten or twelve with turbine engines.

These are all important considerations, and the only serious charge against the turbine marine engine is that while it is more economical of coal at a high speed it is of relatively low efficiency at slow speed. This charge could be ignored in the case of a merchant steamer where constant high speed is the rule and quick time the thing aimed at in a long voyage, but in the case of a warship the lazy rate of progress in cruising or feeling for an enemy would be uneconomical with the present style of turbine. Since the turbine gets 127 expansions against 27 expansions in the reciprocating, and since there is less efficiency in the early expansions of the former than in the latter, the idea is suggested that the turbine might be used to replace the low-pressure cylinder in a compound engine. In this combination, however, the simplicity and compactness of the turbine would be lost along with the more favorable use of superheated steam, so that this hybridizing is scarcely likely to offer the best line of improvement.

The difficulty of reversing is a minor defect in the turbine. The Canadian "Turbinia" has three propellers, one a high-pressure in the middle of the ship, and two low-pressure, one on each side. The latter are reversing, the former non-reversing. The officers say this ship is easily handled when getting in and out of dock.—*Canadian Engineer.*

Technical Publications.

"Elements of Mechanical Drawing." By A. P. Jamison. 226 6x9-inch pages with 82 text cuts and 57 full-page plates. John Wiley & Sons, New York. Price, $2.50.

This book has been prepared as a text book for use at Purdue University. It covers the usual ground of such books in a common sense manner and without fussiness or magnification of trifles. The examples selected are good and well shown.

"Scientific American Reference Book." Compiled by A. A Hopkins and A. R. Bond. 516 5½x7½-inch pages, with numerous illustrations and tables. Munn & Co., New York. Price, $1.50.

The contents of this book are of too varied a nature to admit of satisfactory and brief presentation—a fact which is sufficiently indicated by its triple-column index of 16 pages. The book is largely statistical, many of its facts regarding the growth of population, industries, etc., and the comparison of figures from different countries being in graphical form. It deals largely with shipping, navies, armies, railroads, population, education, telegraphy, patents, manufactures, and mines and mining.

"Fowler's Electrical Engineers' Year Book." By W. H. Fowler. 589 3¾x6-inch pages, with numerous illustrations. The Scientific Publishing Company, Manchester, England. Price, 1s. 6d.

This, the fourth edition of a well-known English publication, has been subjected to the usual annual revision. Additions have been made in the sections dealing with electrical measuring instruments, running dynamos in parallel, the management of dynamos, electrical distribution, secondary batteries, lighting and the application of the alternating current. The recommendations of the British Standards Committee for generators and motors have also been included. The book is a highly useful compendium at a remarkably low price.

"Experiments with Alternate Currents of High Frequency and High Potential," with an appendix on the "Transmission of Electric Energy Without Wires." By Nikola Tesla. 162 5x7-inch pages with 40 illustrations. McGraw Publishing Company, New York. Price, $1.

The main portion of this book is a reprint of a lecture delivered before the English Institution of Electrical Engineers, and the appendix is a reprint of an article contributed to the thirtieth anniversary number of *The Electrical World and Engineer.* Both discuss those strange phenomena with which the author's name is identified. The book will no doubt be widely read among electrical engineers and others who follow the developments of experimental electricity.

"Mechanical Appliances, Mechanical Movements and Novelties of Construction," by Gardner D. Hiscox. 400 9x6-inch pages, 907 illustrations. Norman W. Henley Publishing Company New York. Price, $3.

This work is in the same line and supplementary to the author's previous work on "Mechanical Movements." The devices here shown are mostly more elaborate than those shown in the previous volume and the range is coextensive with human mechanical ingenuity and invention. Perhaps the most interesting chapter in the book is that about perpetual motion. We are assured by the author that "the history of the search for perpetual motion *does not afford a single instance of ascertained success,*" and more than half a hundred illustrations are given of perpetual-motion devices which did not work. The book is well printed, with illustrations on each page and it has a copious index.

"Automatic Surveying Instruments and Their Practical Uses on Land and Water." By Thos. Ferguson. 87 5x7¼-inch pages with 26 illustrations. John Bale Sons & Danielson, London. Price, 4 shillings.

This book describes three surveying instruments for making surveys of an approximate character. The first—the pedograph—is an elaborated pedometer; the second—the cyclograph—is an attachment for bicycles, and the third—the hodograph—for boats. The first is an automatic route tracer for pedestrians, and the second for vehicles, while the third is a self-registering instrument for courses and distances on water. Quite thorough discussions are included of the degree of accuracy attainable by the different instruments, and these are illustrated by actual diagrams made by them, several diagrams of the same routes as made by the instruments being shown and with them in some cases diagrams from surveys by more accurate methods. The results are surprisingly satisfactory. They are, of course, obtained very quickly and indicate an extended field of usefulness for the instruments.

An Engineer Electrocuted.

At West Prince Albert, Canada, November 12, the engineer of an electric station was electrocuted shortly after turning on the lights in the evening. For some purpose unknown he went behind the switchboard, and the first intimation of an accident was when smoke was seen issuing from that quarter. The engineer was found standing holding on to the connections and the flesh burning from his hands. The switch was thrown open and the body dropped on the floor.

The word "linotype," tho now so common, is so modern that it did not get into the Century dictionary. The Standard, however, has it and pronounces it, as we all do, with the first syllable short. The makers of the linotype machine insist that they made the word and have a right to insist also upon its pronunciation, which should be line-o'-type. They will find the enforcement of this pronunciation more difficult than inventing and building the machine, especially as they dropped the "e" out of the word when they made it.

Personal.

Joseph A. Rothwell has just been appointed superintendent of the entire machine, pattern and blacksmith shops of the Pioneer Iron Works, Brooklyn, N. Y.

W. L. Miller, who for some time has been chief draftsman of the J. Morton Poole Company, Wilmington, Del., has returned to Madison, Wis., to become assistant superintendent in the works of the Gisholt Machine Company, in which works Mr. Miller originally served his apprenticeship.

Obituary.

William Barber, for many years chief machinist of the Lardner Point (Philadelphia) pumping station, died November 18, sixty-two years old.

Business Items.

The Northern Enginering Works, Detroit, Mich., report recent shipments of cranes as follows: Bethlehem Foundry & Machine Company, 4-ton electric, 43-foot span; Public Service Corporation of New Jersey, 10-ton, 39-foot span; New York Butchers' Dressed Meat Company, 12-ton, 39-foot span; Union Metallic Cartridge Company, 12-ton, 30-foot span; People's Power Company, Rock Island, 10-ton, 50-foot span; Duluth Street Railway Company, 20-ton electric, special. This company is also putting on the market some electric trolley hoists.

Manufacturers.

The Seneca Chain Company, Kent, O., is building an addition.

A. Newmann & Co., Philadelphia, are about to build a shoe factory.

A wire factory for Petosky, Mich., is being promoted by Messrs. Brackett and Ward.

The Hutchings-Votey Organ Company's plant, Boston, Mass., has been damaged by fire.

The Waterloo (N. Y.) Woolen Manufacturing Company intends to erect new buildings.

The Waterbury (Conn.) Brass Company has taken out a permit to erect a building, 16x69 feet.

C. W. Shumway & Son, Batavia, Ill., have let the contract for a 120x60-foot addition to their foundry.

The contract has been let for an addition to the H. B. Ives factory, builders' hardware, New Haven, Conn.

The Barkelew Electric Manufacturing Company, Middletown, O., has leased, and is fitting up, a larger plant.

The directors of the Southern Tile & Brick Company, Jackson, Tenn., have determined to enlarge the plant.

H. E. Hass, of Beaver Dam, Wis., has moved his gas and gasoline engine manufacturing shops to Fond du Lac.

A building at Cincinnati, O., occupied by the Ansonia Copper & Sheet Iron Works, has been somewhat damaged by fire.

Atchison, Topeka & Santa Fe Railroad officials have visited Shawnee, Okla., and approved plans for a shop building.

A manufacturing branch of the Virginia-Carolina Chemical Company, of Richmond, Va., is being located at Shreveport, La.

A box factory is about to be erected at the corner of Stockholm and Russell streets, Baltimore, Md., for J. S. Asendorf & Co.

J. C. Woodcock, Chillicothe, O., manufacturer of feed mills, has visited Louisville, Ky., in search of a location for a factory.

The contract has been awarded to build two additions to the plant of the Scoville Manufacturing Company, brass goods, Waterbury, Conn.

A cement plant in Brooklyn, N. Y., of the Rockland-Rockport Lime Company, of Rockland, Me., and elsewhere has been badly damaged by fire.

J. F. Zang, Dallas, Tex., is looking into the development of sand in glass manufacture and may organize a company to build a glass factory.

Julius Janowitz, 10 West Eighteenth street, New York city, has bought a site in Long Island City for a factory to make a substitute for whalebone.

Progress is being made in the construction of a large addition to the Newark, N. J., plant of the Westinghouse Electric & Manufacturing Company.

Plans and specifications are being drawn up for a new mill for the Reading (Pa.) Iron Company, to be used in making pipe of 18, 20 and 24 inches.

Alterations and additions are to be made to a machine shop, corner of Magee street and State road, Philadelphia, for the Tacony Iron & Metal Company.

The Cincinnati Southern, besides building or enlarging shops at Somerset, Ky., or Chattanooga, is said to propose to enlarge the shops at Ludlow, Ky., also.

The J. J. Newman Lumber Company, of Hattiesburg, Miss., will erect a sawmill at Sumrall, Miss. The capacity will be 7,000,000 feet of lumber per month.

It is reported that the Pittsburg (Pa.) Dry Goods Company, which owned the Pearce Woolen Mills, burned at Greenville last June, has decided to rebuild at Latrobe.

The Lombard Governor Company, Roxbury, Boston, Mass., manufacturer of water-wheel governors, has purchased property at Ashland, Mass., and will remove there.

William Hjorth & Co., makers of wrenches, pliers and hardware specialties, at Jamestown, N. Y., expect in the spring to erect a new factory building, 40x120 feet.

Plaquemine, La., has granted Victor M. Garber, of Shreveport, a franchise to erect an electric light and power plant. Work is to begin on the plant in a short time.

Peter McConochie, proprietor of the Union Foundry, Machine & Boiler Works, at Lower Slatington, Pa., is erecting a new building, 35x50 feet. He expects also to erect another one.

The Lidgerwood Manufacturing Company, hoisting machinery, etc., New York city, is starting to erect factory buildings in the Newark, N. J., district, to cost about $300,000.

The Cutler-Hammer Electric Company, Milwaukee, Wis., is planning to erect a $30,000 addition to its plant in the Menominee valley at Twelfth street and St. Paul avenue.

The Newark Rivet Works are about to build a factory, to cost $28,500, at 146 Monroe street, Newark, N. J. It will be four stories, 51x190 feet. Contracts have been awarded.

A company to be known as the Nonpareil Cap Company will be organized in Springfield, O., for manufacturing a patent corkless beer tap, the invention of W. A. Baker, of that city.

Plans have been made for alterations and an addition, 35x80 feet, to the factory of H. B. Underwood & Co., manufacturers of portable machine tools for railroad work, etc., Philadelphia.

The stockholders of the Dixie Mills (cotton), of Lenoir City, Tenn., have decided to make great improvements. The company will change its name to the Holston Manufacturing Company.

Hobson & Co., manufacturers of agricultural implements and wagons, Tatamy, Pa., are expected to establish a plant near Easton, Pa., to be in blast by spring and employ about 150 men.

The stock subscription needed to secure the Morse Iron Works for Erie, Pa., has been raised. Mr. Morse has been selecting machinery. The company is organizing with $500,000 capital stock.

The W. H. Bundy Recording Company, Syracuse, N. Y., has decided to put off the erection of the addition to its plant until next year. The calculating machine is being still further improved.

A foundry is being erected to manufacture the newly patented stove to cook over fireplaces, promoted by J. R. Day, of Bessemer, Ala. The plant will have a capacity of about 100 stoves a day.

The Simplex Motor Car Company, incorporated with a capital of $20,000, is expected to start manufacture in the L. H. Van Linter factory building, on South Spring street, Mishawaka, Ind.

The Wheland Machine Works, manufacturer of sawmill machinery and engines, Chattanooga, Tenn., has just completed extensive additions to its plant, which now covers 16 acres of ground.

It is understood that the Broderick-Quinlan Manufacturing Company, boiler manufacturer, Montpelier, Ind., now proposes to include a foundry in its new works to be built at Hartford City, Ind.

Chief Engineer W. H. Brown, of the Pennsylvania Railroad, is stated to have announced that he is ready to receive bids for the construction of a power-house, repair shops, etc., at Washington, D. C.

It is understood that a plant will be built at Galesburg, Ill., by the Galesburg Coulter & Disc Company, in which are interested C. M. Avery, A. J. Perry, B. F. Arnold, John Burnaugh and George B. Churchill *et al.*

An attempt is being made in Jamestown, N. Y., to establish a co-operative manufactory, to be known as the Golden Furniture Company. H. C. Lindross is president and August Saderstrong secretary and treasurer.

The contract has been let for the construction of a pump plant for the Red Jacket Manufacturing Company, Davenport, Ia. Among the buildings are to be a 100x200-foot foundry and 80x200-foot machine shop.

It is stated at Binghamton, N. Y., that Messrs. Newell and Hennessey, lawyers, presumably of that place, have formed a company to manufacture the Holland detachable horseshoe patented by a Binghamton horseshoer.

A. Perrin and Louis Hall, of New York, have purchased from different parties in Eastern Kentucky 23,000 acres of timber lands. The work of development will begin at once, and mills will be built and oil wells put down.

General Superintendent Simmons, of the El Paso & Southwestern Railroad, is now having plans drawn for the new shops which the company will build in Douglas, Ariz. Just when they will be built has not been announced.

It is stated at Fall River, Mass., that A. S. Phillips has gone South on business connected with the purchase of a location for the Southwestern Cotton Mills. He was accompanied by Mr. J. Bion Richards, treasurer of the Davis Mills.

John Morris, president of the Buchanan (Mich.) Business Men's Association, is quoted as saying that the village is to have two new factories, one of which will manufacture steel tools for railroads and the other automobiles.

The Stafford-John Glass Company has been formed at Petersburg, Ind., and will manufacture glass coffins on a large scale. It is organized under the laws of the District of Columbia, and Rev. James M. Stafford, the patentee, is president.

A structure is being erected on Gallagher avenue, close to Logan avenue, in Winnipeg, Man., by Thomas Kirkwood, to be used for the manufacture of railway spikes and bolts. Mr. Kirkwood was the owner of the Belleville (Ont.) Iron Works.

The Light Committees of the Covington (Ky.) General Council have decided to take steps looking to the erection of a municipal light plant by recommending the employment of J. H. Creaghead, electrical engineer, to make preliminary estimates.

Raymond H. Holbrook, a consulting engineer of Chicago, has written parties in Fond du Lac, Wis., regarding the location of a plant for the manufacture of condensers, feed water heaters and other steam specialties of which he is the patentee.

It appears that the plans of the Otto Gas Engine Works, of Philadelphia, to establish their new plant at Wilmington, Del., are, after all, not likely to be changed in favor of Chester, Pa., as reported. The matter does not seem, however, to be fully settled.

Plans have been invited for a machinery warehouse for L. F. Seyfert's Sons, on the north side of Thompson street, Philadelphia, extending from Ninth to Percy streets. It will cover an area 168x100 feet and be equipped with a crane runway 50 feet wide and 165 feet long.

It is stated at Troy, N. Y., that Engineer John F. Kelly (address not given) is organizing a company to erect a factory at Pittsfield, Mass., to manufacture an automatic piano player. The capital of the company will be at least $125,000, and about 100 hands will be employed.

The Goulds Manufacturing Company, Seneca Falls, N. Y., has awarded the contract for building the proposed addition to its machine shop at the Triplex Pump plant on Oak street. It is to be 150x100 feet. The company also thinks of building an iron foundry, some 500 feet in length.

The United States Casket Company has been organized with a capital stock of $80,000, and the plant will be put in the Carroll Bros.' planing mill building in North Broadway, Scottdale, Pa. The mill will be remodeled and enlarged and about $18,000 additional machinery will be installed in the building.

The Consolidated Can Company, which is being, or has been, incorporated in New Jersey with $500,000 capital, and in which men formerly connected with the American Can Company are interested, may, it is reported, establish plants in Brooklyn, Philadelphia, Baltimore and Syracuse. The Chamber of Commerce, Syracuse, N. Y., has some information regarding it.

A new consolidation of certain picture and picture frame, etc., factories in Mexico City, capitalized at $150,000, is to fit up a factory with automatic machinery to make pictures, frames, religious statues, buttons, medallions, etc., and to be run by electricity. H. W. McVickar, whose factory is now in First Calle Guerrero, was to start November 15 for the United States to buy machinery, etc.

The Victor Stoker Company (capital, $200,000), has been formed at Cincinnati, O., is expected to take over the business of the Day-Kinkaid Company, of Harrison avenue, that city, and to build a big plant. Its specialties will include automatic stokers for locomotives and steamships. It is possible that an alliance will be made with the American Stoker Company. The new plant of the Victor Company will probably be located in Norwood.

Parties interested in the Boynton Pump & Scale Company, Toledo, Ia., and the Litchfield Manufacturing Company, Waterloo, Ia., affiliated concerns engaged in the manufacture of pumps, furnaces, track and wagon scales, etc., are organizing a company to do business at Des Moines. A plant has been optioned, and if purchased, a foundry may be added. Among the lines manufactured would be wheel-barrows, swings and patent novelties.

Van Buren, Heck & Marvin Company, manufacturer of traction ditchers, Findlay, O., has lately received orders for ditching machines from different parts of the world, two being from different individuals at Melbourne, Australia; one from France, one from Egypt and an order for a number was daily expected from a man residing in Scotland. A civil engineer from Chili spent several days recently, and left with the assurance that he would order several of the ditching machines.

Plans for an extensive addition to their plant have been adopted by James Leffel & Co., Springfield, O. The addition will be used as a boiler shop, and will be 250 feet long. It will be fully equipped with new tools, propelled mostly by motor power, and with electric cranes. The output of the factory is being sent to all parts of the world, and the company is now building, or has completed a 2,000 horse-power water wheel for the Japanese Government. This is to replace a wheel shipped to the order of the Japanese Government some time ago, but which was sunk in transit by the Russians. General Manager Sparks recently received a telegram that another wheel of 1,000 horsepower had been sunk in another boat, and an order was sent for a duplicate.

Papers incorporating the L. M. Ericsson Telephone Manufacturing Company, under the laws of the State of New York, have been filed; capital stock, $200,000. The incorporators and directors include Axel Bostroem, of Stockholm, Sweden; Fenton M. Parke, a real estate man of Buffalo, with offices in the Prudential Building, and Attorney Carl H. Smith, whose offices are in Ellicott Square, Buffalo. The principal offices will be in the town of Tonawanda, Erie County, N. Y. While the company's plans are not definitely known, it is reported to contemplate building a plant for the manufacture of telephone apparatus under the patents of the Ericsson Company, whose main plant is at Stockholm, Sweden. The report is strengthened by the purchase of a site near Buffalo.

The Standard Roller Bearing Company, of Philadelphia, has purchased from the American Ice Company, a strip of land, 25x100 feet, facing on the main line of the Pennsylvania Railroad, at Forty-eighth street and Girard avenue, Philadelphia, and adjoining the factory of the Standard Roller Bearing Company. The same company has also purchased a tract of land adjoining its factory on the west, fronting on the Pennsylvania railroad about 300 feet, and 200 feet wide. Upon the above land will be erected a steel casting plant and addition to the iron foundry and also a large addition to the factory for manufacturing steel balls, all for the use of the Standard Roller Bearing Company. We understand that not all of the machinery for the company's recent machine shop and ball plant additions has yet been secured.

New Catalogs.

The Laidlaw-Dunn-Gordon Company, Cincinnati, Ohio. Bulletin No. L602, describing a special steam-head for operating deep-well pumps. Illustrated.

Wile Power Gas Company, Rochester, N. Y. Section 1 of Catalog "A," dealing with the uses and cost of producer gas for power and fuel and illustrating types of suction and automatic gas producers recently put on the market by this company. 6x9, pp. 13, paper.

Standard Gauge Manufacturing Company, Syracuse, N. Y. Catalog No. 3 of pressure and vacuum gages for all services, accessories and parts, tachometers, thermometers, water gages, valves, cocks, whistles, etc. Profusely illustrated. 6½x10¼, pp. 103, paper.

The Norman W. Henley Publishing Company, 132 Nassau street, New York. This company has issued a catalog containing descriptions and prices of many Henley books for machinists, engineers, students, amateurs and others interested in mechanics, engineering and electricity. Copies of this catalog will be sent free of charge to anyone interested. 9x11½, pp. 20, paper.

The John M. Rogers Boat, Gauge & Drill Works, Gloucester City, N. J. Catalog No. 7 of the small-tool department of this company shows an interesting line of fixed caliper gages, internal and external cylindrical gages and limit gages, measuring machines, corrective gage standards, reference disks; standard and special reamers and mandrels and McCanna's adjustable thread cutting and milling tool. Illustrated. 6x9, pp. 43, paper.

F. E. Myers & Brother, Ashland, Ohio. General catalog and price list No. 40, illustrating and describing the large line of pumps and tools made by this company, including double acting force and lift, hand, windmill and power pumps, hydraulic, barrel and bucket spray pumps, atomizers, cylinders, pipe, hose, fixtures, etc.; hay tools, hay carriers, hay forks, steel track, pulleys, etc.; also store ladders, door and gate hangers, bicycle stands, etc. Profusely illustrated and fully indexed. 6x9, pp. 374, paper.

Pratt & Whitney Company, Hartford, Conn. "Precision Tools" is the title of an exceptionally fine catalog we have received from this company. It is divided into two sections, the first, "Machine Tools," showing the well-known Pratt & Whitney bench lathes, toolmakers' lathes, small engine lathes and turret lathes and attachments; automatic screw machines, shapers, milling machines, die-sinking machines, profilers and thread milling machines, with some excellent illustrations of typical work produced by the last-named tools; gear cutters, sensitive and multiple-spindle drills; gun barrel drilling machinery, cutting-off machines, roll grooving machines, etc. The second section illustrates the line of small tools made by this company, including taps and dies, milling cutters, reamers, mandrels, etc. The catalog is well printed, in two colors, on coated paper; is illustrated throughout by fine half-tone cuts, and is strongly bound, with cloth board covers. 6x9, pp. 216.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cal.per cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Steel name and monogram name stamps; diesinking: write for estimates. J. L. Lucas, Bridgeport, Conn.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Write for price on only machine shop, boiler shop and foundry in Black Hills. J. C. O'Donnell, Deadwood, S. D.

Electric motors and apparatus calculated and designed by competent engineer. Room 223, 45 Broadway, N. Y. City.

Wanted—AMERICAN MACHINIST, No. 38, Vol. 22, of Sept. 21, 1899; will pay for same. Address R. E. Brokaw, Portland, Ind.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.